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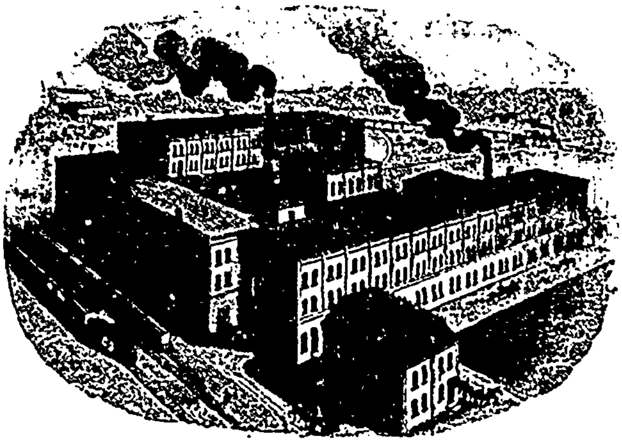
WOOD ARC & SLATTERY INDUCTION SYSTEM

FOR LONG DISTANCE INCANDESCENT ELECTRIC LIGHTING.



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References in Canada:

Halifax Gas & Electric Light Co., Halifax, N.S.

New Glasgow, Nova Scotia

Calkin Electric Light & Power Co., St. John, N.B.

Electric Light & Power Co., Woodstock, Ont.

Electric Light & Power Co., Brockville, Ont.

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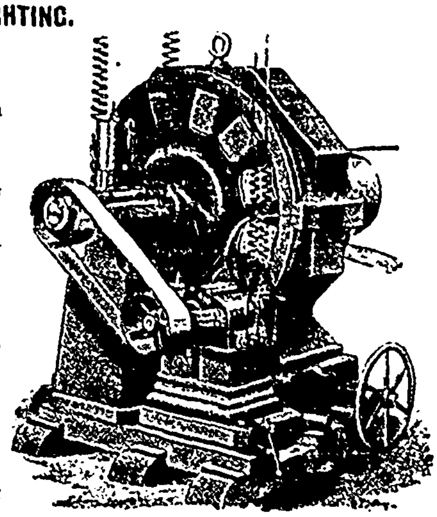
Corporation of Collingwood, Collingwood, Ont.

Niagara Falls Electric Light & Power Co., Niagara Falls, Ont.



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TENDERS.

Sealed Tenders addressed to the undersigned and endorsed "Tender for Indian Supplies" will be received at this office up to noon of SATURDAY 9TH MAY 1891 for the delivery of Indian Supplies during the fiscal year ending 30th June 1892 consisting of Flour, Beef, Bacon, Groceries, Ammunition, Twine, Agricultural Implements, Tools &c., duty paid, at various points in Manitoba and the North-West Territories.

Forms of tender containing full particulars relative to the Supplies required, dates of delivery &c. may be had by applying to the undersigned, or to the Indian Commissioner at Regina, or to the Indian office, Winnipeg.

Parties may tender for each description of goods (or for any portion of each description of goods) separately or for all the goods called for in the Schedules, and the Department reserves to itself the right to reject the whole or any part of a tender.

Each tender must be accompanied by an accepted cheque in favor of the Superintendent General of Indian Affairs, on a Canadian bank, for at least five per cent. of the amount of the tender, which will be forfeited if the party tendering declines to enter into a contract based on such tender when called upon to do so or if he fails to complete the work contracted for. If the tender be not accepted, the cheque will be returned, and if a contract be entered into for a part only of the supplies tendered for, an accepted cheque for five per cent. of the amount of the contract may be substituted for that which accompanied the tender, the contract security cheque will be retained by the Department until the end of the fiscal year.

Each tender must, in addition to the signature of the tenderer, be signed by two sureties acceptable to the Department for the proper performance of the contract on his tender.

This advertisement is not to be inserted by any newspaper without the authority of the Queen's Printer, and no claim for payment by any newspaper not having had such authority will be admitted.

L. VANKOUGHNET,
Deputy of the Superintendent-General of Indian Affairs.

Department of Indian Affairs,
Ottawa, March, 1891.

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CONSULTING ENGINEERS.

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HEAD OFFICE, 2 TORONTO ST.
TORONTO.

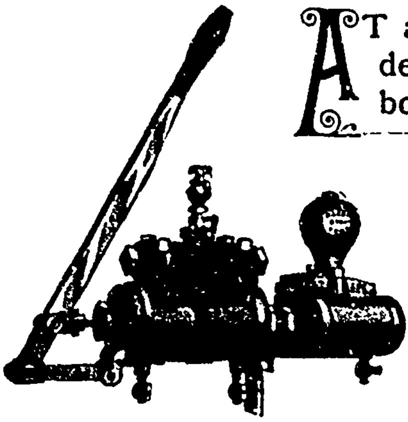
Prevention of Accident our chief aim. Economy of fuel secured.

NOTE—The offices of the Company have been removed from above address to the Canada Life Building.

MARSH INDEPENDENT STEAM PUMP

FOR STATIONARY, PORTABLE AND MARINE BOILERS.

OVER 2,000 MARSH PUMPS SOLD IN THE UNITED STATES DURING 1890



THIS CUT SHOWS SMALLEST SIZE MARSH PUMP, WITH HAND LEVER.

AT a recent test by Prof Cooley, of Michigan University, 48 degrees of temperature was added between condenser and boiler in passing through pump.

Absolute Actuation and Regulation without the use of Tappets, Levers, or other Mechanical Construction.

As the exhaust mingles with feed water and returns to boiler, there is no loss of heat, hence it is the most economical pump in use. For hot or cold water or liquids, with or without Hand Pumping Attachment, NO PUMP EVER MADE THE RECORD OR BECAME SO POPULAR AS THE "MARSH."

Patented in Canada 7th February, 1889.

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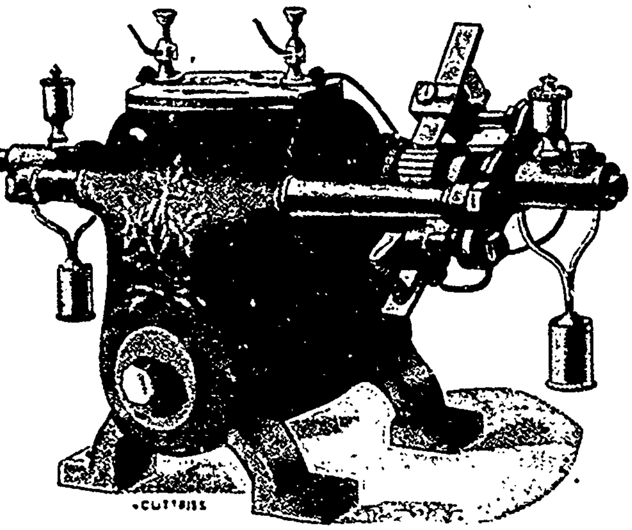

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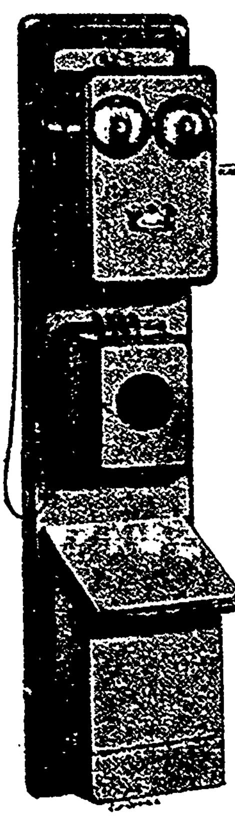

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Our Warehouse Telephones are endorsed by leading business houses throughout Canada. They save time, consequently money. Would they not be a great convenience and a paying investment in your large business establishment? Remember we sell instruments outright at moderate prices. No rentals to pay.

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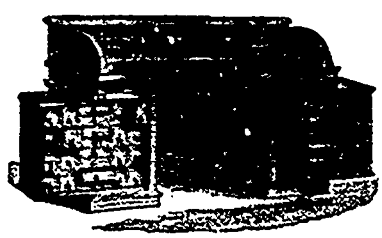

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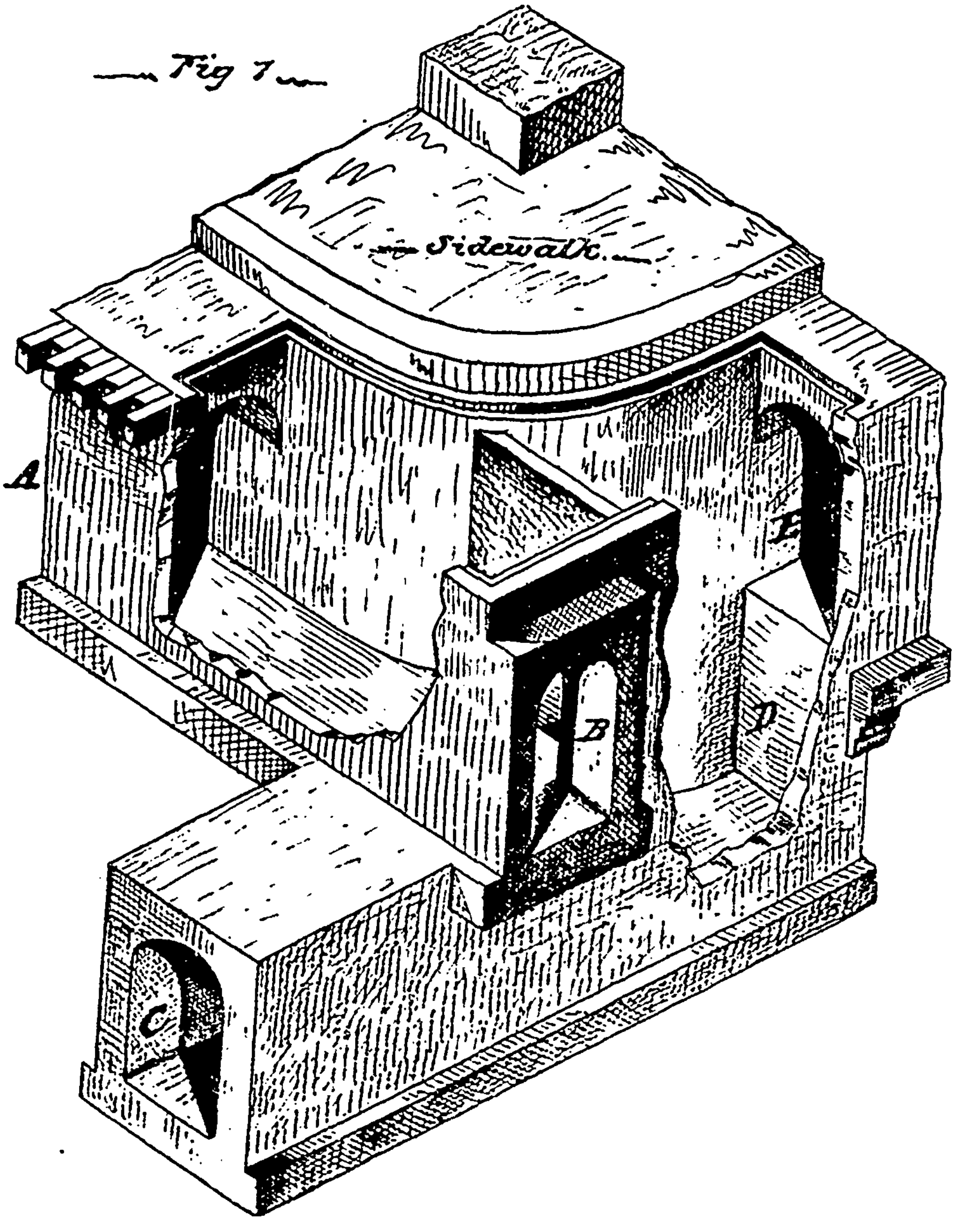
STEAM ENGINEERING JOURNAL.

VOL. I. TORONTO AND MONTREAL, CANADA, MAY, 1891. NO. 5.

DANSEREAU'S ELECTRICAL WIRE SUBWAY.

THE inventor claims as a main feature of his subway the use made of the street water course for the establishment of the conduits intended to receive the electrical wires. At street corners the subways cross one another at right angles, as shown in figure 1. The conduits A B and C D over-lap one another at levels differing as far as D, when the subway is again raised in E. In the conduits are placed cross-bars, shown in figure 2 and fully sketched in figure 3. In figure 4 are represented two different methods of laying the subway; in section *A* the curbstone is independent of the subway, whereas in section *B* the curbstone forms part of the subway.



The advantages claimed for this system of subway are the following.

1st. The use made of the water course, which is paved by the city, and consequently reduces by so much the cost of construction.

2nd. The use made of the curbstone, which affords a space not otherwise taken up either for public or private purposes.

3rd. The cost of construction of this subway which reduced, to a minimum, and the conduits do not in any way interfere with any private or public works.

Mr. M. E. Dansereau, of Montreal, the inventor of the above subway, is prepared to correspond with civic corporations or companies concerning arrangements as to the adoption of his subway.

One of the vexed questions in steam engineering to-day is, of how much use is the steam jacket? Some authorities say it is a valuable addition to a steam engine, others that it makes no appreciable difference in economy, and others still, that it is a source of positive loss.

THE QUEBEC EXPLOSION.

OUR contemporary the *Stationary Engineer*, of Chicago, in a recent issue referred to the Quebec Worsted Mill boiler explosion and gave a description of the arrangement of the boiler fittings and cause of the explosion differing from the account we published.

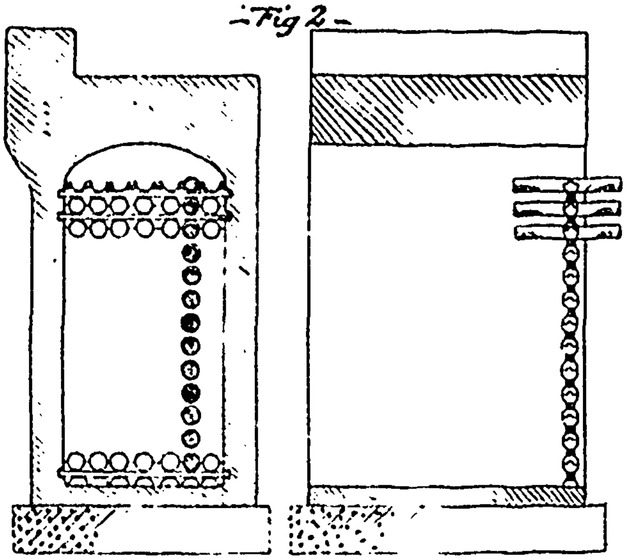
According to this Chicago version, there were three boilers with a large drum crossing over them, and with a shut off valve between each boiler and the drum, and the safety valves—three in number—all on the drum and none on the boilers. Our friend then proceeds: "As we look at the sketch, what little mystery remained about the disaster vanishes, and in its place is astonishment that any man, or set of men, be they owners, mechanical engineers, butchers, boiler inspectors, or just plain, every-day idiots, could have so little common sense as to construct so certain a death trap."

We have taken some pains to find out whether or not there was any truth in this Chicago story. We have positive assurance that the boilers were not arranged as our contemporary describes, but were as we formerly stated, three horizontal tubular boilers, each with a dome of the usual form, and fitted with a shut-off valve between each dome and the main steam pipe, and a safety valve on each boiler and not in any way connected with the steam pipe, and quite independent of the shut-off valve.

Our friend has been misinformed and wasted his thunder. We Canadians are foolish enough and stupid enough, but not quite so verdant as the *Stationary Engineer* would have its readers believe. The safety valve of this exploded boiler was properly placed and of sufficient size, but carelessness had permitted it to become rusted to such an extent that the boiler burst before the pressure was high enough to open the valve.

Our friend says, "There must be some power to compel owners and superintendents to comply with the well understood

—Fig 2—

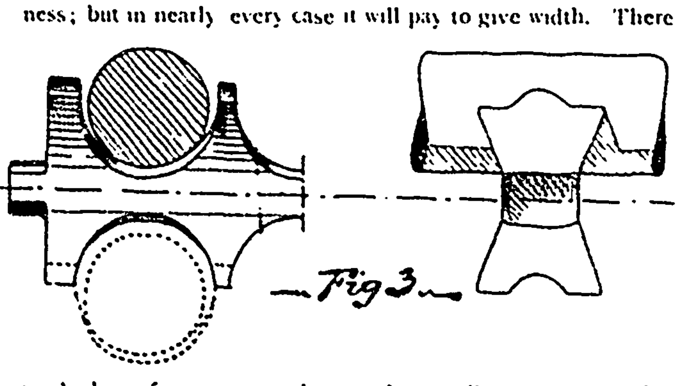


principles, and not allow them to be disregarded, no matter from what cause, whether avarice, carelessness, ignorance or idiocy."

Quite correct! The safety valve should never be stronger than the boiler, but when it is, or is allowed to become so, whether from "avarice, carelessness, ignorance or idiocy," it is better to tell the truth about it than to thunder about "the utterly idiotic lack of intelligence which was responsible for such criminal foolishness."

BELT WIDTH.

SOMEHOW or other, power users seem to be afraid to get belts wide enough to do the work that they put upon them. They will get a double thick belt, or strain what they have to that point at which the lacings are in danger of giving way, and the bearings are being worn by the excessive pull on them; they will daub printers' ink and other messes upon the belt, and do almost everything that they can think of, except get a wide enough belt in the first place. Extra width means extra driving power, so nearly every time, that it may be put down as a working rule. It nearly always means driving power in proportion to the width, other things being as nearly equal as they can be made. Almost any eight-inch belt should drive as much as a four-inch belt of the same thickness, material, condition, tightness, arc of contact, etc. Almost any 12-inch belt will under the same circumstances drive three times as much as the four-inch belt, and half as much again as the eight-inch belt, just like it in every way. It may cost a little more for pulleys of wide face than for those of narrow face; and it will of course cost more for wide belts than for narrow ones of the same thickness; but in nearly every case it will pay to give width. There



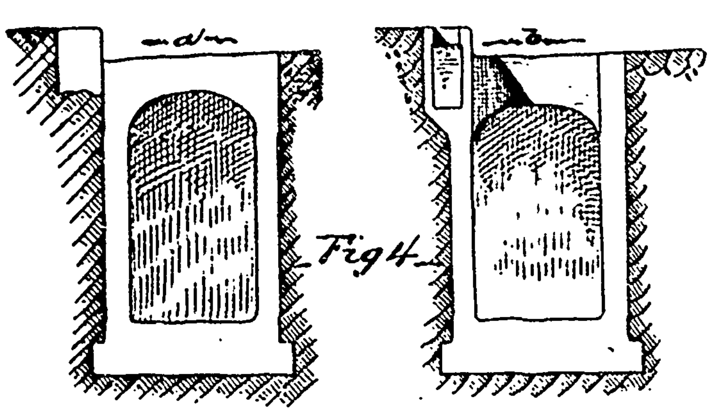
can be loss of time at a machine, and even all through a mill, by failure of a belt to start up with its load. The attendants of a machine may have to wait, every one in the whole establishment may have to stand around until the belt is tightened. This may take an hour. There may be 400 hands (pairs of hands) waiting for that belt to start its load. The extra width of belt, the extra face of pulley, can be paid for by the cost of a very few such stoppages; perhaps by only one.

But it is not always necessary to have extra cost of belt. The extra pulley face will often do the business; using a single belt of double width rather than a double belt of single width. A double belt does not really drive twice as much as a single one. *It seldom drives more than half as much again.* This being the case, it is better to have a 12-inch single than a six-inch double belt. If the belt be laced, the 12-inch single is really stronger as far as driving goes, than the six-inch double, because they are apt to be laced with the same material, or fastened with practically the same fasteners; and as it is the fastening which determines the strength of the belt, you may find that the 12-inch single belt has double as much strength of fastening to stand the strain, as the six-inch double.

There is one thing to be said about doubling the width of the belt to get double the drive; it will sometimes fail because the belt is too rigid to bed down well; and in such cases it will often be found that two six-inch belts, side by side, will drive more than one 12-inch. Of course a rubber belt can not be cut down the middle any more than a canvas one; but leather ones generally can, and this will often be found a good remedy when a wide belt will not drive. Of course when it is a question of substituting a wide belt for a narrow one, there is less difficulty and expense in getting another one of single width, than in discarding the first one and getting one of double width. The question is one of pulleys only.

Where there is considerable crown on a pulley and it is found by the appearance of the side next to the pulley that it is not bedding well, that the edges do not touch the pulley, the trouble may often be cured (with a leather belt) by scouring it down the

—Fig 4—



middle, half way. If it be a double belt it may be cut down through the outer layer only. *Mechanical News.*

BOILER PLATES.

THE methods employed by Messrs. Cramp in the building of a large modern boiler, with thick plates for high pressures, are thus described:

The plates are, in the first place, pickled in a wooden bath containing a 5 per cent. solution of sulphuric or hydrochloric acid. After remaining in the bath for about six hours, they are removed and thoroughly scrubbed with hickory brooms, while a strong stream of fresh water is played upon them. They are then immersed in a bath of lime water to neutralize any remaining acid, and again washed with clean water. All holes are drilled, and the edges of the plates are planed and bevelled for calking. The shell plating is bent cold to the proper curvature in the rolls. The flanging is done by Tweddle hydraulic flanger, the plate being heated to a bright cherry red. A length of about eight feet can be flanged at each heat. Furnace mouth plates are flanged in cast iron dies at a single heat.

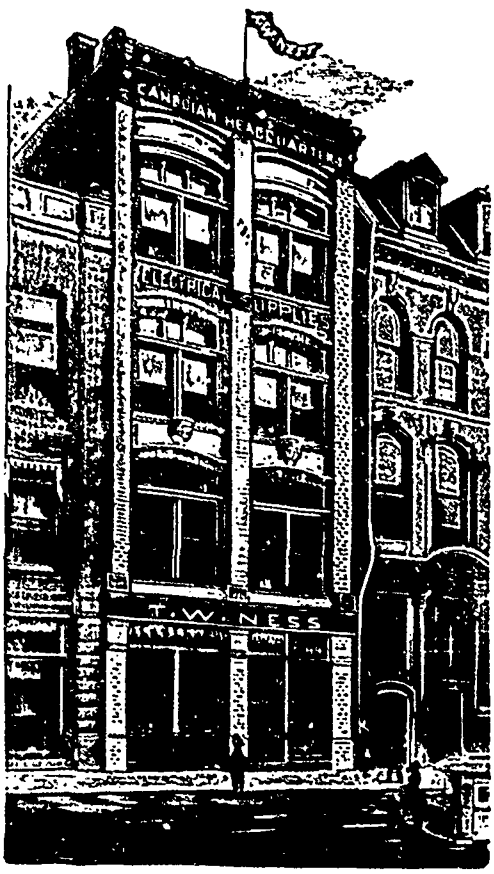
After the flanging of tube plates, etc., is completed, they are reheated, and the plates are straightened on a cast iron surface plate, and finally they are annealed by cooling in the open air from a cherry red heat.

The riveting is performed by a Tweddle hydraulic riveter, using a pressure of 1,500 lbs. per square inch on the flange, which gives a stress of about 90 tons on the rivet. The stay tubes are screwed into both tube plates and expanded, the ends in the combustion chamber being beaded over.

A MONTREAL ELECTRICAL SUPPLY HOUSE.

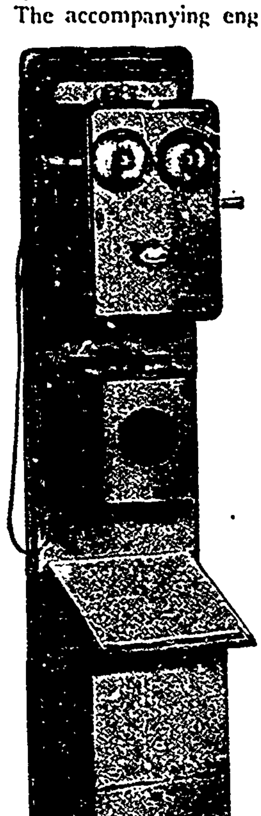
We present to our readers herewith a brief description of an interesting visit which our Montreal representative made to the establishment of T. W. Ness, 644 Craig street, in that city.

Our correspondent writes: This firm is rapidly building up a

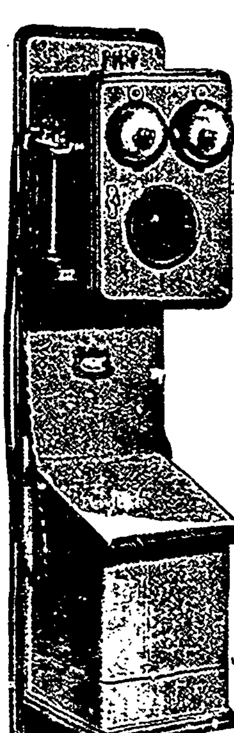


very large trade in electrical supplies. They have been running at full time all winter, and are still behind with orders, shipments being frequently made as far west as British Columbia, and to Newfoundland eastward, and each mail bringing enquiries from all parts of the Dominion.

The accompanying engraving will give a fair idea of the



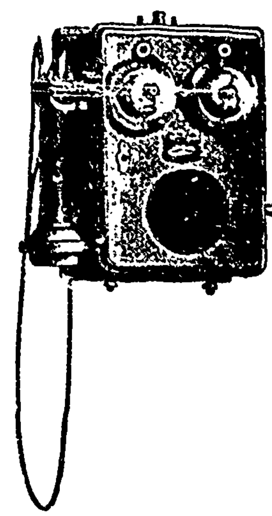
No. 1.



No. 2.

extent of the present premises, five flats being occupied exclusively by this one firm, the ground floor as an office and the others for show-rooms and factory, thus enabling the manager to have a personal supervision over all the work, which is in itself a great advantage.

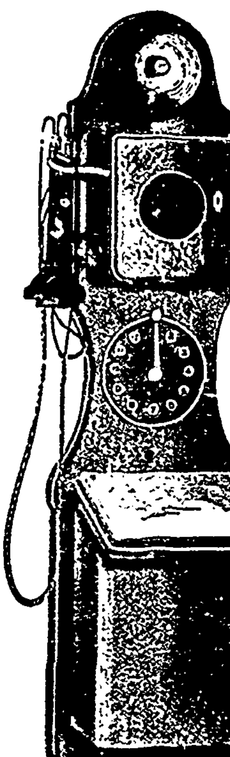
As manufacturers, a specialty is made of telephones, which are turned out in first-class order, thoroughly tested, and ready to be connected the moment received. Cut No. 1 shows the Exchange Pattern instrument, similar to the Bell. Cut No. 2 gives a cheaper form, having a transmitter and magneto combined in one box. Cut No. 3 represents a very neat telephone, so constructed that it may be placed on the desk, at the end of a flexible cord, for convenience in moving from one part of the desk to another, or, if desired, it can be mounted on a brass fixture with a swivel, thus enabling one to turn it aside when not in use. A small dry battery is used for this instrument, and may be placed in a drawer. This is a very convenient arrangement, and quite popular, especially with office managers. Warehouse telephones are also manufactured in large numbers, and so arranged that each instrument has its own switchboard, enabling any room or flat to communicate with any other, and, when calling, no bell rings other than the one wished for, (see cut No. 4.) The telephone department is in charge of a foreman who has had many years experience in Canada and the States and is a practical workman.



No. 3.

A large business is done in annunciators, which are here manufactured in a large variety of styles. Some of the largest public buildings in Montreal contain annunciators bearing the name of T. W. Ness, among the largest being one of 200 drops recently supplied to the Balmoral Hotel, connecting the different rooms with their office. Many special orders are received, but the principal kinds in general demand are the "Norway Iron Gravity Drop," the "Needle Annunciator," and the "Ness" Special Drop, fitted up of course in every possible style of case, but usually in oak, walnut, cherry, or ash; some very handsome frames were noticed in course of manufacture.

The machinery is all run by electricity. Your correspondent made particular inquiries in reference to the satisfaction given by this as compared with *steam or other motive power*, and the men all expressed themselves as perfectly satisfied with the system, and there is no doubt whatever that electricity has already become the most desirable power that can be used, as the running cost is practically nil, and the results perfection.



No. 4.

We were personally conducted through the spacious, *well-lighted* show-rooms. Everything to delight the heart of an electrician, from bells, batteries, induction coils, magnets, and telegraph instruments for the amateur, to motors, incandescent lamps, and electrical books for the more advanced students. A splendid assortment of combination fixtures, electroliers, and electric light shades of all sizes, shapes and colors is shewn. Electrical clocks, ventilation fans and electric gas lighting are all in active operation, every shelf, counter, and show-case often giving a practical demonstration of a few of the many uses to which electricity is now being adapted. This house controls the Canadian agency of some of the special lines, such as "The Connecticut Motor," "The Auburn Watchman's Clock," "The Bundy Workmen's Time Recorder," "The Edison Lalande Battery."

We are pleased to note that the firm mentioned has succeeded in establishing such a good connection, and are sure that our electrical friends will be consulting their best interests by writing them for quotations.

MR. JAMES McARTHUR.

THE subject of the accompanying sketch is Mr. James McArthur, present President of the British Columbia Marine Engineers Association No. 1, which was formed at Victoria, B. C., in the early part of 1890. Mr. McArthur was one of the charter members, and has from the first taken a very lively interest in the organization and success of the Association.

Mr McArthur is a son of old Scotia, having been born at South Queen's Ferry, Scotland, on the 22nd of March, 1850. He commenced to learn the engineering trade at an early age, serving an apprenticeship at the Paragon Works of James Dundas, of Dundas, Scotland. After working as a journeyman for a short time, he left Scotland in the employ of Tennant & Co., of Leith, by whom he was sent out to British Columbia in 1871 in charge of four traction engines for the late Mr. F. Barnard, who intended to use the engines to haul supplies to Barkerville. The enterprise, however, fell through, owing to the bad state of the roads, although Mr. McArthur succeeded in getting the engine he was in charge of considerably farther than was believed possible.

Mr. McArthur was next employed by the Kurtz & Lane Co. as engineer at the mines at Cariboo, but the mines not paying well, he returned to Victoria and engaged as chief engineer of the steamer "Cariboo Fly" for Messrs. Moody, Deitz & Nelson. Leaving this firm he became master mechanic for the Hastings Saw Mill Company for three years. In 1875 he purchased a half interest in the stern wheel steamer "Beaver," which ran on the Stickeen river. The following year she was lost, and Mr. McArthur returned to Victoria and took service in the then new Pioneer Line founded in 1877 by Capt. John Irving. He has since remained with this company, now the Canadian Pacific Navigation Co., Ltd., and is now chief engineer of one of the best boats, the "R. P. Rithet."

Mr. McArthur is a man who has made a host of freinds, and by dint of hard and steady work and shrewd investments has accumulated a good share of this world's goods. He is married, and has a family of bright boys and girls. He is a prominent member of the Freemasons, Oddfellows and A. O. United Workmen, of the last he is a charter member. Having the confidence and esteem of his employers and the respect and admiration of his friends, Mr. McArthur is to-day one of the most popular engineers in British Columbia.

MR. JAMES McARTHUR.

NEW INSULATING MIXTURE.

A NEW insulating compound called "volite" is thus described. It is composed of a mixture of gelatine (specially made), resin oil, oxidized linseed oil, resin and paraffine. It is cheap, and contains no sulphur. The proportions of the mixture are: Glove glue (*colle de gants*), 1,000 parts; resin oil, 100 parts; oxidized linseed oil, 500 parts; colophane, 150 parts; paraffine, 250 parts. The glue is prepared by taking the refuse clippings of gloves, and soaking them in cold water for one night. The next day they are strained, and washed in several waters until the water is clear. In an iron boiler there are then placed 1,000 parts of water, five parts of carbonate of soda, and dry glove skin 250 parts. This is boiled for six consecutive hours, the water being renewed as it evaporates. The whole boiling mass is next run over a sieve, across which steam is passed to prevent the gelatine coagulating. The boiling solution is received by a wooden tub, through which a current of warm air is passed for one hour. The residue left in the sieve is boiled up with water for three hours, and when filtered can be used again for dissolving the glue, but this time with only 200 parts of glove skin. The gelatinous solution is put into a boiler with the olein or oleic acid used in candle manufacture in the proportion of gelatinous solution, 1,000 parts; olein, 80 parts. This is boiled for half an hour, after which ten parts of caustic potash solution (fifty parts water) is added. The boiling is maintained for an hour, so as to saponify the olein and form a soapy pulp. The glove glue prepared, resin oil, linseed oil, colophane and paraffine are added in the proportions above stated; the whole is boiled until homogeneous. This boiling generally lasts about four or five hours.

Revue Industrielle.

QUESTIONS AND ANSWERS.

"W. I." writes: Can you inform me as to what is wrong with my engine? It is a slide valve cylinder 12" x 20", revolutions 200 per minute. It seems to run very well until the large planer goes on, and then it loses speed.

ANS.—You do not give data enough for us to answer your question. Your governor may be at fault, your steam pipe may be too small, the valve may be set wrong, or be leaking, the piston may leak, or perhaps the engine is too small. Send us along full data and we will try to help you out.

"J. D." writes: I have a 6" single leather belt running 1,600 feet per minute. The driver is 40" in diameter, and the driven 18". What horse power should this belt deliver?

Rule—Divide the number of square inches in contact with the pulley by 2; multiply this quotient by the velocity in feet per minute, and divide by 33,000. ANS.—You will have 4 ft. of belt contact on small pulley lever $48'' \times 6'' = \frac{288''}{2} = 144'' \times 1{,}600 = \frac{230{,}400}{33{,}000}$ $= 7\frac{1}{4}$ very nearly; it would be safe to say $7\frac{1}{4}$ H. P.

"Engineer" asks: What would you recommend for taking out the scale that has become pretty badly crusted on the flues and bottom of a boiler?

ANS.—Slippery elm, flaxseed, ground sumac or any other mucilaginous seed or bark thrown into the boiler will loosen the scale, which can then be removed through the hand holes. When using any substance to remove scale, the boiler should not be allowed to run too long without cleaning out, as the loosened scale may accumulate on the bottom of the boiler and cause the sheet to burn.

"T. W." says: I am making a glass plate electric machine. Can you tell me how I can make the hole in the centre of the plate? I have tried twice but broke the plate each time.

Answer: Glass may be readily drilled by using a steel drill, hardened but not drawn at all, wet with spirits of turpentine. Run the drill fast and feed light. Grind the drill with a long point and plenty of clearance, and no difficulty will be experienced. The operation will be quicker if the turpentine be saturated with camphor gum. Large holes will require a tube-shaped tool with fine teeth like a rose-bit, using the same solution.

"J M." asks. What would be the best way to determine the horse power a given belt would be capable of transmitting?

ANS.—The horse power of belting or the tractive force exerted by leather bands of a given width at a certain speed expressed in foot pounds or in any other positive way, is not generally known. There are some half-dozen rules professing to give a unit for horse power, but they are obviously incorrect. A horizontal belt of a given length will drive more than a vertical belt of the same length, a long belt more than a short one, and a twisted belt more than either, because in the case of the horizontal and the long belt the sag and weight tend to produce closer contact and resist strain better than where the belt merely hugs the pulley by its tension; the same is true of the crossed belt which embraces more of the circumference of the wheel driven. From six to eight hundred feet per minute for a one inch belt is said to give a horse power; three to four hundred for a two inch belt will give the same, and so on in inverse ratio.

Mr. J P. Crawford recently delivered an interesting and instructive lecture on "Electricity and its Application to Light and Heat" before the members of the Hamilton Association.

ON THE STRENGTH OF TRIPLE-RIVETED BUTT-STRAP JOINTS.

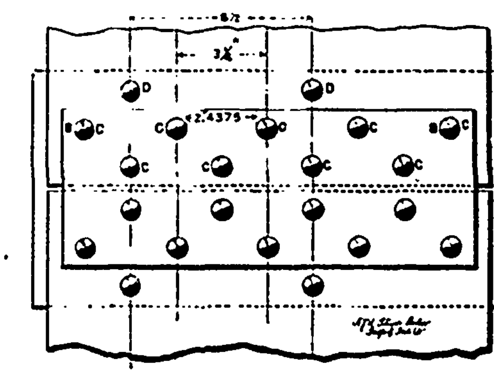
In the October issue of the *Locomotive* we gave Mr. John H. Cooper's solution of a problem in riveted joints, and in this issue we take pleasure in reproducing a solution of a similar problem by Mr. Van Clain, of the Baldwin Locomotive Works. The dimensions of the joint in question are as follows. The plates are of steel, ⅜ of an inch thick, and with a tensile strength of 55,000 pounds to the square inch. The rivets are of iron, ¾ of an inch in diameter, with a shearing strength of 45,000 pounds to the square inch. In the double riveted portion the pitch is 3¼ inches, and in the outside row it is 6½ inches. The problem is, to decide what the strength of the joint is, in terms of the solid plate, and in accordance with the Philadelphia City Ordinance, which does not expressly provide for joints of this character. Mr. Van Clain's solution of the problem was given in the September number of the *Locomotive*; but, as it was there given, it contained several typographical errors, which have been corrected in what follows:

There are three ways in which a joint of this character may fail: (1) by shearing all the rivets, which involves rivets *D* in single shear, and rivets *C* in double shear; (2) by a fracture of the plate across the line *BB*, and a simultaneous shear of the rivets *DD*; (3) by a fracture of the plate along the line *DD*.

Let us consider a portion of the joint 6½ inches long, say the portion included between the two long vertical lines passing through the rivets *DD*. The strength of the solid plate in a unit of this length is

Strength of solid plate = 6½ × ⅜ × 55,000 = 134,062 pounds.

If the joint break in accordance with the first supposition, there are four whole rivets, *CCCC*, to be double-sheared, and one whole one, *D*, to be single-sheared. The diameter of the hole filled by



the rivet being, say, 13-16 of an inch, the sectional area of each rivet is .5185 sq. in. Hence

Shearing strength of *CCCC*	= .5185 × 4 × 2 × 45,000 =	186,660 lbs.
Shearing strength of *D*	= .5185 × 1 × 45,000 =	23,332 lbs.
Strength of joint, on supposition (1) =		209,992 lbs.

The diameter of the hole filled by the rivet, 13-16, when expressed decimally, is .8125. If the plate breaks across *BB*, in accordance with the second supposition, the effective section in the part of the joint under consideration is reduced by twice this amount on account of the two holes punched or drilled for the rivets *CC* that lie on the line *BB*. Hence, the effective width of plate along this line is

6.5" − (2 × .8125") = 6.5" − 1.6250" = 4.875"

Hence, the resistance of the 6½ in. section to fracture in this manner is

Tensional strength of plate along *BB* = 4.875 × ⅜ × 55,000 =	100,547 lbs.
Shearing strength of one rivet in row *DD* = .5185 × 1 × 45,000 =	23,332 lbs.
∴ Strength of joint, on supposition (2) =	123,879 lbs.

On the third supposition, we have merely to break the plate across

6.5" − .8125" = 5.6875".

Hence, tensional strength of plate across *DD* = 5.6875 × ⅜ × 55,000 = 117,305 lbs.

In accordance with the Philadelphia rule, we are to take the least of the three strengths of the joint computed above, and divide it by the tensile strength of 6½ inches of the solid plate, which strength we have already found to be 134,062 lbs. Obviously, the joint is weakest along the line *DD*, so that we have to call its strength 117,305 pounds. Hence, the percentage of strength of the joint is

117,305 ÷ 134,062 = 0.875

Hence, the joint, in its weakest part, has 87½ per cent. of the strength of the solid plate.

It may be well to say that the number 2.4375 in the cut represents the distance in the clear from edge to edge of the rivet holes, though for the sake of clearness, it is shown as though it extended only from the head of one rivet to the head of the next.

IT LITERALLY FILLS A LONG-FELT WANT.

KINGSTON, April 18th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR, I have received four issues of your valuable paper, the ELECTRICAL NEWS, and I find each number more interesting. It was just what we needed in Canada. I often felt annoyed that we were compelled to go to the States for such information, but thanks to your efforts that is now a condition of the past.

Yours respectfully,

CHAS. BAYLIE,

Electrician Kingston Penitentiary.

HORSE-POWER OF ENGINES.

Editor ELECTRICAL NEWS.

DEAR SIR,—Mr. John Galt, C. E., undertakes to act as a "governor" to me as to rate of travelling of horse to find horse-power of engine. This is all right as long as the "safety" and "throttle" valves are untampered with, the work will still go on with perfect "safety." I find it is necessary now for me to act as an "automatic regulator" to him, in that matter, to put him on *terrr firma*.

Horse power of steam engine is only a conventional way of expressing a certain size engine, and no two makes of engines are alike as to their horse power. But we will assume that H. P. is definite and alike in all engines for the sake of argument. All engineers from Watt down, except Mr. Galt, agree that a horse can exert his power to better or all advantage at two and a half miles per hour or 220 feet per minute, and *take that rate in calculating*. Mr. Watt calculated his H. P. on the largest London horse (Bourin). He was desirous of his engines doing all the work possible, or of rating them higher rather than lower, so that where steam was substituted he could dispense with a greater number of horses to do the work required.

Mr. Galt says that "rate at which horse is travelling is only one element in the calculation." Certainly it is only one element but it is *the* element that is wanting in his calculation.

Again, he says "note the rate at which the horse is travelling has every thing to do with the effect but has nothing whatever to do with the result." In mechanics this is incompatible. As I said before if you do not take the rate at which the horse travels into calculation, why take into calculation the rate at which the engine travels? The one must, of necessity, have the same units as the other in order to compare them, *which is 220 ft. per minute for rate at which horse travels*, in calculating the H. P. of steam engines. For illustration: H. P. of steam engine in numerator; power of horse in denominator

$$\frac{33{,}000 \text{ lbs.} \times 1 \text{ ft.} \times 1 \text{ minute} \times \text{speed of piston}}{33{,}000 \text{ lbs.} \times .1 \text{ ft.} \times 1 \text{ minute} \times \text{what?}} = 1 \text{ H. P.} + X,$$ when

rate at which horse is required to travel is not taken into calculation. In formula form it is thus for calculating the H. P. of an engine.

Let A = area of piston.

P = steam pressure.

S = distance travelled by piston in feet per minute.

$$\text{H. P.} = \frac{A \times P \times S}{33000 \times 220}$$

If you would build an engine, by your formula, and guarantee it to be of a certain H. P., it would be like the New York street car horse—you would have to sing "Little Annie Rooney" to it before it would "budge" at the stated H. P.

We are all differently constructed—see, feel and think differently, and have different opinions. I like to see a man have his own opinions, and have backbone enough in him to assert his opinions, whether right or wrong.

Anyone who wishes to pursue the subject further may with profit study any of the following works: "Hutton's Practical Engineers' Handbook," "Mechanic's Own Book," Rankin's "Manual of the Steam Engine," Northcott's "Steam Engine," &c.

D. W. ROSS,

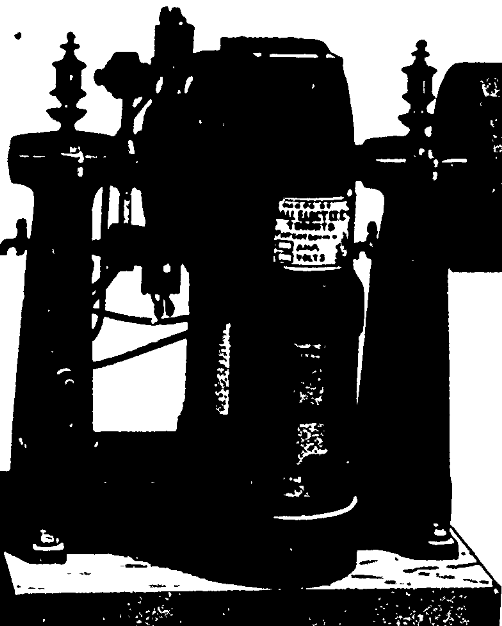
C. & M. E.

BALL INCANDESCENT DYNAMO.

THE dynamo illustrated herewith is manufactured by the Ball Electric Light Co., Ltd., 70 Pearl street, Toronto. While its general design cannot be claimed as entirely novel, yet there are many details of design and construction that are new. These combined with the high-class workmanship and good material used throughout, make, it is claimed by those competent to judge, one of the most efficient and best operating incandescent dynamos on the market. The makers claim it can be built and sold at a price which will make it an object to any consumer of 25 or more lights to own and operate their own dynamo, especially where they are already using power, or where a boiler is used for heating purposes.

The Ball Company also supply an automatic condensing engine for residence and shop use for driving these dynamos where other power is not available. These engines operate it is claimed at a cost not to exceed one cent per horse power per hour, and require but slight attention.

The general details of this new dynamo are as follows: A "Gramme" armature of the usual Ball type is used having a number of sections; this armature is securely mounted on a gun metal expanding hub. There can be no electrical connection between the wires of the armature and the hub and shaft, and no magnetic connection between core of armature and mounting hub, and consequently no tendency for the current to leave its usual path and no loss from magnetic leakage and foucault currents. The commutator is of tempered copper, and plates of ample length and section and insulated with mica. Carbon brushes are used on the commutator, and the machine operates without spark. On account of great depth of plate, the commutator will last for years without renewal. A newly patented brush holder very simple in design is used, giving a constant and adjustable spring tension on the carbon brush; this is a very important point and one which has hitherto been lacking in most dynamos. The magnet cores are of the softest special wrought iron. The inner surface of poles and the standards for bearings are bored at one operation, insuring perfect alignment. As gun metal interchangeable self lining and self oiling bearings are used, there can be no difficulty from heating of journal. These machines operate at very low speed, and as they are compound wound the regulation from no load to full load is automatic. These machines are wound for incandescent lighting in sizes from sixteen to one hundred and twenty five 16 c.p. lamps, and for arc lighting, from one to twenty five lights in either 2,000, 1,500 or 1,000 candle power. The Ball Company are also supplying the same class of machine wound for motor work for use on incandescent circuits.



BALL INCANDESCENT DYNAMO.

The above cut was taken from a 40 light incandescent dynamo. The larger sizes are built with a frame of different shape from above, bringing the base line nearer the shaft, so that in all of these machines there is an entire absence of any vibration which might otherwise be caused by pull of belt or speeding.

The Ball Company report a large demand for these machines, and a number of various sizes already installed are giving good satisfaction. A full assortment of sizes are kept in stock ready for shipment.

The first electric tramway for mining purposes to go into operation in Canada, will be put in the New Vancouver coal mines at Nanaimo. The plant, of which the first instalment will cost $20,000 consists of an 80 horse power generator, and two 30 horse power electric locomotives, each of which will haul at a speed of nine miles an hour, 150 loaded coal cars. Other generators will be used to furnish a current for light in the mines. Current will also be employed in working electric coal drills and cutters.

SPARKS.

An electric plant to be used for street lighting has arrived at Moosejaw, N. W. T.

Negotiations are in progress for lighting the village of Tottenham by electricity.

Heat produces electricity and electricity produces heat, magnetism produces electricity, and electricity produces magnetism; light produces electricity, and electricity produces light.

One part by weight of Greek pitch and two parts of burnt plaster is said to form a new insulation for electric wires which will stand either unusual heat or moisture. It is applied while hot by means of a brush.

A visit of inspection was made recently to the Edison Company's new works at Peterboro, by Mr. Francis, auditor of the company, and the manager of the company's works at Schenectady, N.Y. Some of the new buildings at Peterboro will shortly be ready for occupation.

An agreement has been concluded between the city of Winnipeg and the Austin street car company, by which, on the introduction of electricity, the company's franchise is to be extended twenty-five years beyond the expiration of the present charter. Twelve miles of the electric road are to be built in 18 months.

An ingenious "cut off" for electric light fittings has been invented in England. Its novelty consists in securing the lead wire by two eccentric pinches, and in the fact that, should the wire melt from over current, the cover (which has an internal stud resting on the wire) will fly down, thus indicating what has happened.

The annual report of the Royal Electric Light Co., of Montreal, is considered by the directors to be of a satisfactory character. A quarterly dividend of 2 per cent. has been paid to shareholders after making additions to capital account. The prospects for the ensuing year are good. The officers and directors were all re-elected.

Time and trouble will be saved when winding armatures and field coils, by connecting a bell with one or two cells of battery to the armature or field core by means of a brush or swivel in the wire, and connecting the other end of the circuit with the end of the wire that remains on the spool. Any break in the insulation that permits a short circuit between the winding and the core will cause the bell to give instant notice of the fault.

The economy in large dynamos, it is said, will not come in their first cost, but in the expense of running them after installed. A 400 h. p. generator will cost to manufacture twice as much as a 200 h. p. machine. About twice as much material will be put in the former as in the latter, unlike a steam engine, but there will be a saving in winding the fields and armatures. The larger casting and a greater difficulty in finishing the base and other casting pieces will make up to an extent that which will be saved in winding the fields and armature. After the machines have been installed and put into operation comes the saving. Less care and consequently less labor will be required to keep them running properly, and as the speed will be materially lower, averaging from 300 to 400 revolutions per minute at their maximum, the possibilities of burning out an armature are much reduced from what they would be with an 80 h. p. generator, whose armature makes from 700 to 800 revolutions per minute.

Dr. Edward Tatum has recently completed some remarkable experiments on the physiological effects of alternating currents, says the New York *Electrical Review*. He finds that the danger of the current diminishes as the number of alternations per second is increased. Thus it took twenty times as strong a current to kill a dog when the alternations were 4,500 per second as when they were 120 per second. When the alternations were 300 per second, the current was only half as dangerous to life as when the alternations were 120.

We find this in an exchange: The introduction of electrical power into all the available mechanics of industry is but a question of time and the necessary economics in cost and application. The cutting of veneers is a new field for the magic force. The machine lately introduced, instead of cutting or shaving around the entire circumference of the log as usual, takes a thin slice from the flat side of it. The logs are of any diameter and are cut into lengths of 10 feet. It is fastened to two cranks. Between two parallel shafts a veneer-cutting knife is stationed, and the log is carried up and down in front of it with a circular motion by a revolving of the cranks, and is fed against the knife by a ratchet and pawl in the ordinary manner. This is the first instance on record where an electric motor has been used for this work. In the case here referred to, a 15 horse power machine is used for the purpose and the connections are made with the electric mains in the street. It is giving great satisfaction.

ENGINEERS' COMPETITION.

TORONTO, April 20th, 1891.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR, The papers for the Engineers' Competition which you handed to us for examination have been carefully gone over by us, and as a result we have to report that Mr. A. E. Edkins, engineer at Messrs. T. Eaton & Co.'s, Toronto, is entitled to the first place, and that Mr. G. C. Mooring, engineer at the Methodist Book Room, Toronto, is entitled to second place. Mr. Edkins received 510 marks out of a possible 670, and Mr. Mooring was not very far behind, his losses being mainly in the answers to three questions.

We regret that so many engineers in the country did not avail themselves of this competition, as we are convinced a large number could have answered the questions with a little study.

We hope that at some future time you will see your way clear to give them another opportunity.

Yours very truly,

GEO. C. ROBB,
A. M. WICKENS.

The following table shows the number of marks obtained by each candidate:—

	Wm. Sutton.	G. C. Mooring.	A. E. Edkins.	E. Tipton.
No. 1	20	15	10	10
" 2	30	40	35	—
" 3	45	60	60	60
" 4	20	20	20	20
" 5	30	60	50	20
" 6	70	80	80	
" 7	30	20	40	—
" 8	15	20	15	15
" 9	20	20	40	—
" 10	—	—	—	—
" 11	20	30	60	—
" 12	—	40	30	—
" 13	10	10	20	—
" 14	20	30	20	—
Neatness	10	—	30	
Total	340	445	510	125

The questions submitted for solution in this competition and the answers given by Mr. Edkins, the successful competitor, are printed below.

1. What is a horse power as applied to a boiler?

Answer—The basis on which the H. P. of a boiler is rated is the evaporation of one cubic foot of water at 212° to steam, per H. P. per hour. This rating was established some time before the automatic cut-off engine came out, and when the actual consumption of engine was about that figure. In my opinion the term H. P. of a boiler is very vague, and depends on the relative economy or wastefulness of the engine. I believe that the modern high grade automatic cut-off engine, working non-condensing, will in ordinary practice develop two H. P. to every one H. P. at the above named boiler rating. The amount of heating surface in the ordinary tubular boiler which is necessary to evaporate one cubic foot of water is conceded to be 15 sq. ft., and it is generally allowed that that amount (15 sq. ft.) is equivalent to one H. P. in a tubular boiler, also 12 sq. ft. in a locomotive type of boiler, and 9 sq. ft. in a plain cylindrical boiler is equal to one H. P.

2. How much is gained if feed water can be had at 120° temperature instead of 40°?

Answer—7½ per cent. is gained.

3. With water at 40° fed into the boilers, and steam taken off at 90 lbs. pressure, how much coal should be required for each thousand gallons of water used?

Answer—1250 lbs. per 1,000 gallons, but I think in practice more than this would be necessary.

4. What would be the safe working pressure for a horizontal tubular boiler, 64 inches diam., 14 feet long, with 90 tubes, 3 in. diam., shell made of 60,000 lbs. steel plates ⅜ in. thick, and double rivetted in longitudinal seams?

Answer—The safe working pressure is 98 lbs. per sq. in. (Reed's rule).

5. Give size of furnace for soft coal for such a boiler, and size of smoke pipe, and area and height of a chimney for a range of six boilers of same dimension?

Answer Area of furnace, 2,475 sq. ft. = 4' 6" × 5' 6" Size of smoke pipe, 5' 6" × 6'. Area of chimney, 30 sq. ft. Height, 100 ft.

6. An engine has cylinder 18 in. diam., and 18 in. stroke, and makes 240 revolutions per minute. Steam is supplied at 90 lbs. pressure in boilers 30 ft. away. What size should steam pipe be?

Answer—Size of steam pipe should be 6".

7. With steam cut off in above engine at ⅙ in. of the stroke, and discharged into a heater open to the atmosphere, what horse power can be got?

Answer—I find by building a theoretical card under these conditions, that I get a M. E. P. of 34 lb. and 194 H. P.

8. If a condenser be added, maintaining a vacuum of 26 in. on the guage at the condenser, what *additional* power could be got from engine?

Answer—By adding a condenser would gain 20 per cent.

9. What difference to the amount of fuel per horse power per hour should there be between above engine using a heater giving water at 190° and using a condenser, maintaining a vacuum of 26 in., and supplying feed water at 100°?

Answer—There will be a difference of 55 lbs. of coal per H.P. in favor of condensers.

10. If engine speed varied while the pressure of steam and load were constant, what should be done to remedy the defect?

Answer—There are several things that would cause an engine to vary in speed, under these conditions, for instance. The centrifugal force of the fly balls of governor not being correctly counter-balanced, the fly wheel might not be of sufficient weight, the governor belt might not be sufficiently tight to prevent slipping.

11. In a high speed automatic cut-off engine, what is the effect of the weight of the reciprocating parts on the steadiness of motion?

Answer—The effect is to equalize the pressure on the crank pin this way During the first half of the stroke the reciprocating parts are being rapidly accelerated in motion, and while such is the case, they absorb considerable of the work done by the pressure of the steam on the piston, and, after mid stroke, give off this same amount of work on the crank pin in coming to rest. All the work done on the piston (minus friction) is transmitted to the crank pin, but the crank pin is protected from the tremendous blow which it would otherwise receive when steam is admitted to cylinder, by the weight of the reciprocating parts and for these reasons I would say, the effect is to equalize the pressure on crank pin.

12. The duty of the governor is said to be to regulate the speed; upon what conditions does its power to regulate depend?

Answer—Upon the governor balls being properly counterbalanced, and the fly-wheel being of sufficient weight, also that governors be kept in a proper state of lubrication.

13. What are the advantages of "compression" in the steam cylinder?

Answer—The advantages are that when properly utilized it can be made to fill the clearance space at initial pressure, and if this is done, there is no great loss by clearance. It also forms an elastic cushion, and this assists to bring the piston easily to rest at the end of each stroke. It also, when properly used, prevents the piston from sustaining any shock, when steam is admitted to cylinder, and in performing these functions, it tends to makean engine run easily and smoothly.

14. Describe the defects in the annexed diagram, and state what should be done to remedy them.

Answer—This card indicates that everything is late opening and closing. I would put the eccentric forward the necessary amount. It is possible that the steam pipe, or ports, or exhaust pipe or ports, are too small; judging from card I would say they are.

The answers given by Mr. G. C. Mooring, the winner of the second prize, are as follows:

No. 1. Watts' standard, one cubic foot of water evaporated in one hour; but of later date, and with an automatic engine, 30 lbs. evaporated per H. P. per hour.

No. 2. 7½% saving.

No. 3. If 70% of the heat in the coal can be utilized, it would require 1,160 lbs. of coal per 1,000 gallons of water.

No. 4. 98·437 lbs.

No. 5. Rate of heating surface to grate surface, 45 sq. ft. to 1, equals 26 sq. ft. Smoke pipe connection, 27 sq. ft. area. Chimney, 110 ft. high. 33 sq. ft. area.

No. 6. Steam pipe, 6".

No. 7. 230·46 H. P.

No. 8. 25% additional power.

No. 9. Saving of fuel, 8%.

No. 10. Make the governors work right.

No. 11. They assist the governors.

No. 12. Upon its being properly balanced in proportion to its work, and to be kept clean and well oiled in every part, allowing it to regulate the valve or valves with the highest variation of speed.

No. 13. It forms a cushion to ease the engine off centres and partly fills the ports, thereby saving live steam.

No. 14. The valves are late in all their movements. Advance the eccentric.

RECENT CANADIAN PATENTS.

No. 36074. John Platt, Removing incrustation.
No. 36075. " Cleaning boiler.
No. 36094. M. Swinbourne, Ball valve.
No. 36098. G. E. Hitch, Storage battery.
No. 36116. Jos. Burns, Hydro carbon burner.
No. 36135. E. R. Gill, Electric circuit controlling apparatus.
No. 36195. E. Fales, Generating steam.
No. 36196. P. Fitzgibbons, Boiler.
No. 36214. H. Patterson, Steam boiler.

TRADE NOTES.

It is at this period of the year that the engineer's thoughts sorely turn to remembrances of heated axles, hot boxes and such; and he sadly wonders if a heated axle can make life in this world so unbearable, what must it be in the hereafter? The engineer is necessarily a man of intelligence, of quick perception, and of a trained and disciplined mind. He is capable of judging a good thing when he gets it, and once he gets what he wants, no counterfeit fakes need apply. The engineer who is worried just now about hot boxes has not tried Spooner's Copperine, otherwise he would be wondering why earth should be unhappy while Heaven leaves us Youth and Love, and Spooner gives us Copperine.—Bobcaygeon *Independent.*

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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 result of the Engineers' Competition instituted by the ELECTRICAL NEWS for the benefit of its subscribers, is given in the present number. Answers to the questions propounded were received from only *four* engineers. The lack of interest thus indicated is at once surprising and disappointing. It was the intention that this competition should be followed by others, but under the circumstances it would seem advisable to postpone further efforts in this direction until Canadian engineers feel the need of and manifest some desire for self improvement.

THERE is much disappointment expressed by representatives of the electrical industries of the United States as the result of the recent discovery that the dimensions of the proposed electrical exhibition buildings in connection with the Worlds' Fair are inadequate for their purpose. Unless the chief architect can be prevailed upon to change the plans which have been prepared, the electrical exhibits, instead of being centered in one building, must be distributed amongst several. Such a distribution would be most unsatisfactory both to exhibitors and visitors. It is, to say the least, peculiar that Prof. Barrett, Chief of the Department of Electricity in connection with the World's Fair, seems not to have been consulted in a matter of such importance.

AT the request of a number of our subscribers, we have opened in the present number of the ELECTRICAL NEWS a question and answer department, which it is hoped will become one of the most valuable features of this journal. Every man who finds himself called upon to operate electric or steam plant, is confronted occasionally with puzzling problems, the solution of which he would thankfully be made acquainted with. When the reder comes across a knotty problem of this nature, let him bethink him of the question and answer department of this journal. Write down as concisely and clearly as possible what you want to know, and every effort will be made to supply you with the information. It is not expected, however, that you will be like a sponge, absorbent only, we want your assistance in answering questions whenever you may be in a position to give it.

APPLICATION has been made to the Council of the city of Toronto on behalf of the Toronto Telephone Company, a new organization, for permission to string wires and exercise privileges similar to those enjoyed by the Bell Company. That the application is supported by the signatures of 2,000 ratepayers, is sufficient proof that the telephone users of the city are not satisfied with the present condition of affairs, under which they undoubtedly are compelled to pay too high a price. If two telephone companies were in operation, however, a telephone of each system would become a necessity, precluding the possibility of lessening the cost and complicating matters in such a way as to add to the annoyance which not unfrequently is experienced where only one system is in use. A plan preferable to that of bringing into operation a second company, would be to place such restrictions upon the existing company as would insure to the citizens a cheap and effective service.

THE season is now rapidly approaching when it behooves the careful manager of a central electric plant to look well to his lightning arrester, or if he has not such a useful little contrivance on his lines, to see that a sufficient number are placed there without delay. In the early days of electric lighting, numerous casualties happened to dynamos without any apparent cause. Some of these were no doubt due to defective insulation, but the majority of cases owed their origin to the insidious but lively spark of static electricity. It was not at all necessary for the trouble to happen in the midst of a howling thunder storm where there could be no mistake at all about the wires being "struck by lightning" as a self-evident fact. A very slight atmospheric disturbance, in an electrical sense, perhaps even on a clear night, might be abundantly sufficient to produce a tiny spark which, jumping from the wire of a dynamo to the iron core, carried with it the current of the machine. In fact, instances have been frequent where the static electricity generated from the driving belt has grounded the dynamo current and burnt out the machine. At all events, all wires running on poles should have efficient lightning arresters where they enter the building of the central station. This is especially necessary now where circuits of from ten to twenty miles are of common occurrence. The loss of time and expense caused by the grounding of the current on the core of a single dynamo would more than pay for a complete outfit of arresters for a whole station, and it is an occurrence likely to happen a number of times in a single season in an unprotected establishment.

THE town fathers of West Toronto Junction are making such an exhibition of the results of municipal handling of an electric light business as to afford a pointed illustration of our oft repeated opinion that the exploiting of such things should be left to private enterprise. They have been at it nearly a year now. Some months ago a by-law was passed appropriating fifteen thousand dollars to be expended in purchasing electric light plant, but so far nothing has been done except to squander the town's good money in a councilmanic jaunt to various cities to see electric light. This would not be so bad, or so much worse than is usually the case if they had stopped the excursion when the municipal grant was all expended, but to continue the trip to various cities at the expense of a would-be contractor was a glaring breach of the unwritten law of good taste, as well as a direct violation of the statutes in that case made and provided. It requires no great strain on the English language to designate a free excursion at the expense of a tenderer on a corporation contract as a method to produce an undue influence, or in other words, to act as a bribe in their favor when the award is considered. It now appears that while the committees have been wrangling over the merits of their various favorities they have allowed the time to expire during which they should have given notice to annul the gas contract. The constituents of these civic solons will therefore have the privilege of revelling in the semi-darkness of the gas lamps for another year at least. When the immortal Winkle was out shooting, Sam Weller suggested that as they would likely come up with a covey of partridges in the next field, he had better begin to fire at once and he would perhaps get the shot out of the barrel by the time the birds would rise. Perhaps if the West Torontonians begin in earnest to get their electric light system, it might possibly be in operation before the expiration of the extra year that fate has so kindly vouchsafed to them.

THE suggestion made by Mr. Gibson in his capacity of Chairman of the Legislative Committee to the delegation of stationary engineers who recently waited upon that Committee, was an exceedingly good one and one that the engineers would do well to seriously entertain. It was that they should endeavor to obtain a legal standing by means of a charter, something after the manner of the Architects Association, and themselves appoint a Board of Examiners, who would have power to issue diplomas or certificates of competency to the members. These would undoubtedly carry much weight with steam power owners desiring the services of the best and most skillful men. The association could then, by a guarded and careful use of the powers conferred upon it, raise the standard of qualification considered necessary for the position of a first-class engineer without doing injustice to a large class of men, perfectly practical and able to fill minor positions with acceptance, but who would be unable to pass an examination in the higher branches of the art. The Bill before the Legislature for the inspection of boilers and licensing of engineers is presumably introduced for the protection of the public, and in the public interest. This being the case, it is difficult to see why steam powers under fifteen horse power should be exempt. It is notoriously this class of boilers that cause the most trouble, and the reason is not far to seek. They are usually tended by men or boys with no special qualifications for the work, and who frequently have the most of their time and attention occupied by other matters. Large installations of steam power are usually in the hands of men who know enough not to risk their own lives or the lives of the public, whatever they may know about the economical management of the machinery under their charge. The opposition developed to the passage of the Bill in question was no doubt largely due to this appearance of class legislation, but if the Association had under their own control, in the manner suggested by Mr. Gibson, the examination and certificating of their own members, the difficulty would be obviated by a proper grading and classification according to competency and experience. An employer would then by application to the society be enabled to obtain a man who could be relied upon as competent to take charge of anything from one horse power to one thousand, as might be required. And now a word in the ear of our friends of the engineering society. Remember that no amount of legislative enactment will increase the value of the services of an incompetent or careless man, or raise the standard of the profession. You have in your own hands the means of attaining a higher position and increased emolument, but it will not be by an Act of Parliament or by assuming any position that savors in the slightest degree or has the most remote appearance of an attempt at coercion. Leave such things to those whose intelligence and abilities are not great enough to place them on a higher plane. You can do it by making for yourselves and your society a reputation that will *command* respect. Let your members be painstaking and conscientious in the discharge of their responsibilities. Waste no time in listening to the blatent harangue of the demagogue or in profitless hunting around for the few soft spots that may perchance be found admidst the hard and stern realities of life, but rather seek to improve the precious moments by an earnest endeavor to attain that knowledge and perfection of skill that shall compel the attention of those whose province it is to judge. Do this, and see that there is no favoritism in your recommendations, but that a high standard of merit and character is required, and your certificate will be more sought after and carry more weight than the best of government endorsement which any man, whatever his character may be, could probably purchase by the judicious expenditure of a five dollar bill.

PERSONAL.

Friends of Mr. J. A. Ferguson, the able chief engineer of the Toronto water works, will regret to learn that he is incapacitated by illness from performing his duties for a season.

Mr. O. P. St. John has resigned his position as steamboat inspector at Toronto, and has gone to British Columbia as the representative of the Doty Engine Co. of this city. Mr. St. John possesses the practical and scientific information, which added to a kind, gentlemanly demeanor, will undoubtedly secure for him and the company he represents a large measure of success.

The following comparison shows the great economy of electricity over water power for elevators: The duplex steam pump uses 8 pounds per hour for each h. p.; the engine which drives the dynamo to furnish electricity to the same extent uses, at most, 4 pounds. Only one-fifth of the power developed in the driving engine is used for operating the elevator. The safety appliances of one kind may be applied to all.

WHAT HAPPENS WHEN THE VALVE OPENS.

By A. N. Somerscales.

So long as a safety valve remains shut, the steam pressure *acting on the underneath side of the valve is opposed by the* weights of the load resting on the top, which may be either dead weight, a helical spring, or an arrangement of one of these acting through the agency of a lever.

Now, either by calculation or by trial, it is possible to proportion the load to the area of the valve so that the valve shall be lifted off its seat when the steam has reached any particular pressure fixed upon as the blowing-off pressure.

Thus, if the area of the under side of the valve exposed to steam is exactly 12 square inches, and the steam is required to blow off at 100 pounds per square inch above the atmosphere, it will be necessary to provide a load $12 \times 100 = 1200$ pounds upon the valve, including the weight of the valve itself.

It is thus clear that the first condition, namely, that the valves shall open when the pressure reaches a certain determined amount, is not difficult to fulfil.

But now consider what happens when the valve opens.

The slightest amount of lift off the seat allows the steam to escape in all directions through the annular orifice between the edge of the valve and seat.

Its velocity is very great—probably 800 feet per second.

The steam in the immediate neighborhood of the valve seat escapes first, and its place is necessarily taken by other steam from the boiler, which also escapes.

A current is thus set up, not only through the orifice furnished by the valve, but also through the pipe leading to the same.

Now, a fluid will not commence to flow unless there is less pressure in front than behind.

When we find, therefore, that the steam is rushing up the pipe leading to the valve seat, with any considerable velocity, we may be certain that there is less pressure at the top of the pipe near the valve than at the bottom of the pipe next the boiler.

In the case of a dead-weight valve, if it has to remain open and permit steam to escape, there must be as much pressure under the valve as balances the load on top.

And as we know that the pressure under the valve is less than the pressure in the boiler, the sole condition under which the valve can be kept open and allow steam to escape is that there must be some (however slight) accumulation of pressure in the boiler over and above the load on the valve.

For example, we may suppose the valve loaded to 100 pounds per square inch, and the difference in pressure between the top and bottom of the pipe to be 4 pounds when the steam is escaping.

Under these conditions the boiler pressure will become 104 pounds when blowing off.

To trace the action of the valve more closely, we may say that when the steam first begins to blow off, the valve will rise a very small distance off the face—so little indeed that the velocity of the steam up the pipe will be small, and the reduction of pressure at the under side of the valve inappreciable.

The small orifice thus opened being insufficient to relieve the boiler, an accumulation of pressure will result.

The extra pressure acting on the valve will increase the lift until the reduction of pressure through the velocity of the steam in pipe is only just sufficient to balance the load on the valve as before.

If the boiler is still making steam faster than it is escaping, a further accumulation will occur, and a further adjustment take place.

But at any instant the pressure on the under side of the valve will always be 100 pounds above the atmosphere, even when the accumulation of pressure in the boiler is considerable.

Now, in order to prevent any considerable accumulation of pressure occurring when blowing off, it has always been the practice to make safety valves very much larger than the size of orifice actually required for the escape of all the steam which the boiler can make.

If an area of about one-thirtieth of a square inch is actually required for the steam to blow through, the board of trade requires an area of half a square inch in the safety valve.

Such being the practice, it follows that safety valves only need to lift a small fraction of an inch off their seats when blowing off, thus avoiding much accumulation of pressure due to the cause we have been considering.

STEAM ADMISSION.

I.

In every line of business some men are content to go on year after year doing the same kind of work in the same way. If asked why it is done in such a way and not in some other way, they can give no better reason than "It has always been done this way." There is no royal road to a knowledge of engineering, and the man who is too indolent to think for himself, or to discover any better reason for doing a thing in any particular way than that "it was done that way before," had better find an easier occupation. The man who has charge of a steam engine should be master of the engine, so far as knowing how to keep it in order and make it do the work it was intended for.

The action of steam in the engine is a subject well worth studying, and every man who runs an engine should know at least something about it, and of the reasons why one engine works better than another. One point to which too little attention is given is the admission of steam to the cylinder. The aim of correct admission is to get, as nearly as possible, the full boiler pressure on the piston at the right time. What constitutes the right time need not be considered at present, as it is a different question from that now under consideration.

With any given engine, how may the engineer know whether or not it is possible to get anything near the boiler pressure into the cylinder? The quantity of steam to be transmitted from the boiler into the cylinder in a given time is what really determines the matter.

As a matter of fact, a loss of ten pounds, or fifteen pounds, between the boiler and piston is not uncommon. Engines can be made that the difference will be so little as hardly to be discernable. It has been proved that if in following the piston, or rather in driving it, the steam has to flow through the pipes and ports at a velocity higher than one hundred feet per second, there will be a loss of pressure; but if the steam pipe and ports are made so large that the steam velocity through them is one hundred feet per second or less, then there will be scarcely any loss of pressure, unless from the condensation that takes place when the pipes are not properly protected.

This, however, does not give an immediate answer to the problem, because the question arises, what is the velocity of the piston? At the beginning and end of each half revolution, it has no velocity, and at about half stroke it is going as fast as the crank pin, while the number of feet travelled per minute is much less than that travelled by the crank pin.

Take for an example the case of an engine with a cylinder eighteen inches in diameter, and a stroke of three feet, and intended to be run at eighty revolutions per minute, what size should the steam pipe be in order to admit full pressure up to half stroke? In this engine the piston will travel four hundred and eighty feet in a minute, but at about half stroke it will be moving at a rate of nearly seven hundred and fifty-four feet per minute.

It was stated that the steam should not move faster through the pipe than about one hundred feet per second, that is, six thousand feet per minute; now if the piston is moving only seven hundred and fifty feet per minute, the area of the steam pipe may be as much less than the area of the piston as seven hundred and forty is less than six thousand.

The rule may therefore be stated thus: Multiply the area of the cylinder by the speed of the piston at the point in the stroke to which boiler pressure is required to be maintained, and divide by six thousand, and the result is the area of the steam pipe.

In the example considered, this rule would call for a steam pipe six inches diameter, but if the full pressure is to be maintained for only quarter stroke instead of half stroke, then the mean piston speed of four hundred and eighty feet may be taken instead of the highest piston speed, and a pipe five inches will answer.

A SIMPLE STEAM PRESSURE CALCULATOR.

By Wm. Cox.

The accompanying diagram, an original design by the writer, is a species of circular slide rule by which the theoretical average pressure per square inch resulting from any possible cut-off and initial pressure can be instantly determined, or conversely, given any average pressure, the several combinations of cut-off and initial pressure which will produce it can be at once determined.

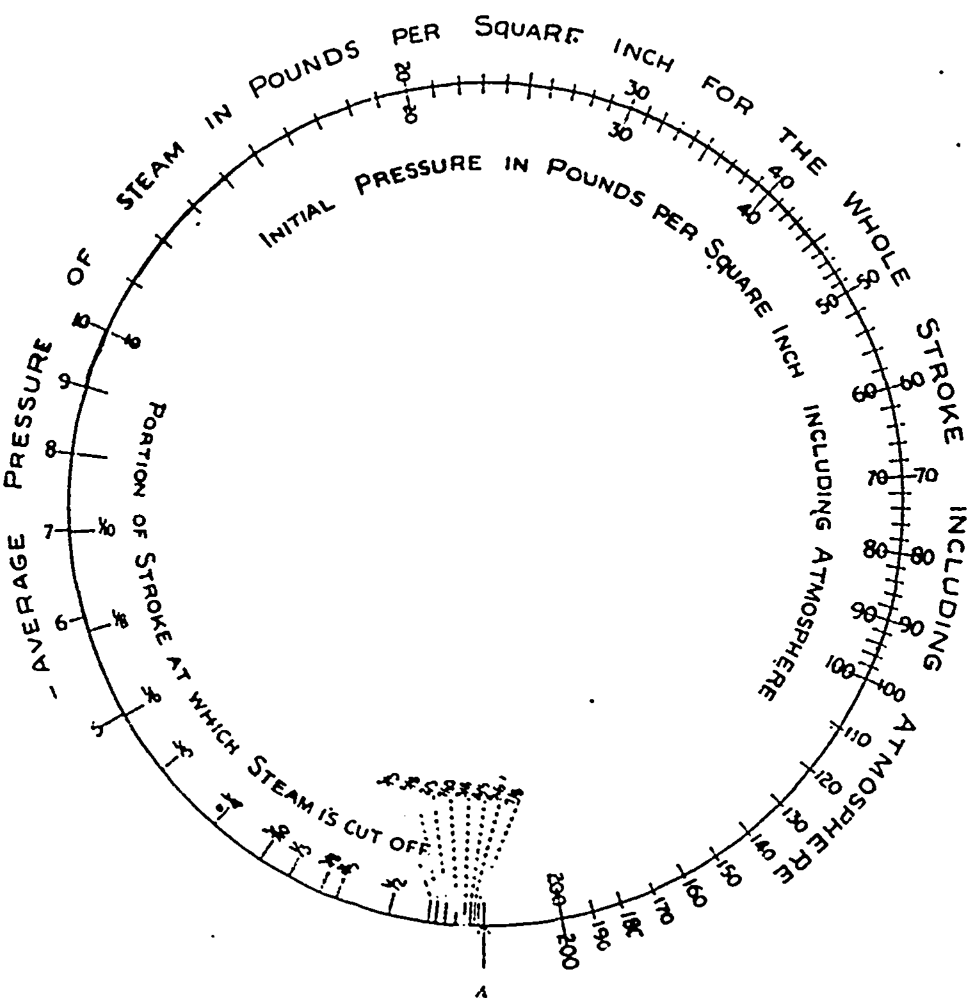


Diagram for Calculating Steam Pressure.

The diagram is not ready for use in its present form, as printed, however. To prepare it for use: Cut out the square space of blank paper on which the diagram appears, and mount it on a square piece of card-board. Then cut the central disk free very carefully, so that it may be an exact circle. Glue the outer part of the sheet to a second piece of card-board, and fasten the central disk to it by a pin passing exactly through its center so that it may be free to revolve within the outer part, and flush therewith.

When this is done, if any given ratio of expansion be set at the arrow, the diagram will show all possible combinations of initial and average pressure which can result from that ratio.

The diagram N indicator is based on the formula.

$$p = P\frac{(1+H)\times l}{L} \text{ or } = P\frac{1+H}{R}$$

where L=Length of stroke in inches.
l=Distance travelled by the piston before the steam is cut off.
R=Ratio of expansion=$\frac{L}{l}$.
H=Hyperbolic logarithm of R.
P=Initial pressure of steam in pounds per square inch, including atmosphere.
p=mean pressure during stroke in pounds per square inch, including atmosphere.

This formula is solved by the diagram at a single setting for all possible values of any of the variables.

To find the mean pressure: Set the "portion of stroke at which steam is cut off" ($l \div L$) on the disk, to the arrow on the indicator; then, coinciding with the "initial pressure of the steam" on the disk will be found the "mean pressure" on the indicator.

No allowance is made for imperfect vacuum.—*Engineering News.*

THE ENGINEERS' BILL.

By "AUTOMATIC CUT-OFF."

MR TAIT'S Bill before the Legislature for the licensing of engineers and the inspection of boilers seems to be meeting with some opposition. Nearly all the members think some kind of legislation would be advisable and acceptable to the people. The promoters of the Bill feel sure that a law such as that asked for by Mr. Tait would be satisfactory to steam users and engineers alike.

In support of the stand they have taken, they cite the instances of the several places where such laws are in vogue, and from all reports are accomplishing the objects for which they were passed. The Dominion marine laws have been in force for many years, and no explosions or loss have occurred. The steamboat owner ha· · aped the full benefit of the law, for he can engage an engineer to-day very nearly as cheap as he could before the law was passed, and any difference in wages is more than made up by the greater efficiency of the men.

In several of the states such laws have been in force, and the reports are all favorable. In North Dakota, last year, there were no explosions, against five the year before, killing eight and injuring nine persons. In this state all boilers come under the law, and there are several hundred threshing boilers and engines. In the state of Minnesota also, all boilers are under the Inspection Act, and all engineers must be licensed. The reports to the State Secretary show a clear record, and the steam user is satisfied with the change. All the larger cities have such laws; some of them have been in force several years, and all are satisfactory to employers and men alike.

The farmer and the saw mill man in the Ontario House are the strongest opponents of the Bill this year, and their avowed reason is that they will have to pay more money for engineers under the Act than without it. This the friends of the Act deny, claiming that it would not have that effect unless the Bill was so framed that it made of the engineers a close corporation, such as that composed of lawyers, doctors, or dentists. As the Bill does not do this, the matter of wages will still be regulated by supply and demand, and will not be influenced in any way by the Act.

More than half the number of explosions occurring in America are due to saw mill and agricultural boilers. The owners of such boilers are the most active in opposing the Bill.

It is more than probable that the result will be a permissive measure framed after the style of the Architects' Bill. This will have the effect of making a standard for engineers, and will go a long way to improve the efficiency of the men that apply under the Act for certificates.

PRIME CAUSES OF BOILER EXPLOSIONS.

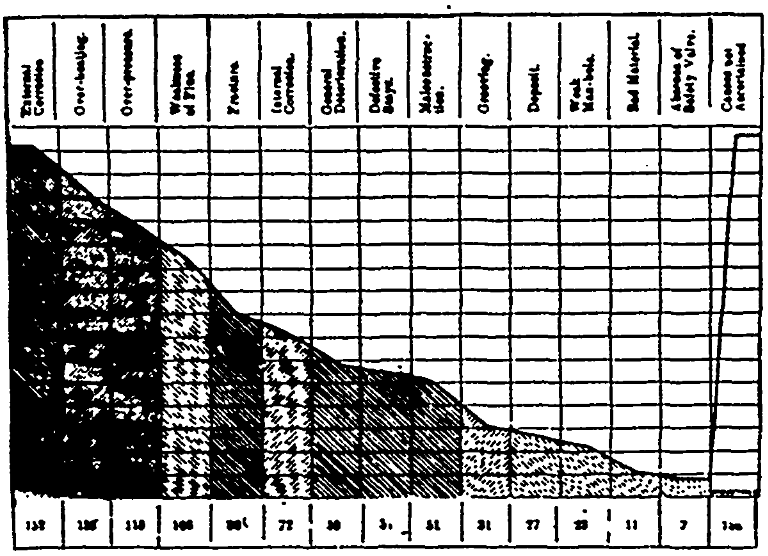
WE are indebted to ***Industries*** for the diagram, which shows graphically the causes of boiler explosions, notably in the case of land boilers. This diagram is based upon an analysis of available reports of boiler explosions extending over a series of years.

The diagram was prepared by Mr. B. H. Thwaite for a lecture on steam generators, delivered weeks ago at the Yorkshire (Eng.,) College Textile Society. It reveals the fact, in a striking manner, that the causes are divisible into the following categories :—

1.—Through the influence of thermic action.
2.— " " " " chemical action.
3.— " " " " physical action.
4.— " " " " structural defects.
5.- " " " " defective supervision.

The diagram also shows clearly the necessity of using a form of steam generators not liable to corrosive effects, and points to the desirability of care being exercised in thoroughly draining the foundations of steam generators of the Lancashire and Cornish type, because by capillary attraction the water ascends through the flue walls until it reaches the shell plates of the boiler, and local corrosion is at once set up, which continues insidiously destroying the safety margin of the plates. The action is probably accelerated by the alternate effects of dampness and the contact of heated gases, resulting from the stoppage of the boilers each week end. This diagram might with advantage be placed in the hands of all those who are responsible for the safety of steam boilers.

We may add that it proves, still further, that the advantage of having boilers covered by assurance, and by a company which bases its insurance upon careful and frequent inspections, cannot wisely be gainsaid.



NUMBER OF EXPLOSIONS FROM THE CAUSES ENUMERATED ABOVE.

ENGINEERING IN BRITISH COLUMBIA.

VICTORIA, B. C., April 18th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Having read your article on the Quebec boiler explosion in the April number of your journal, it grieved me very much to see that the inspection of stationary boilers should have been entrusted to such an incapable man as the Quebec inspector is shown to have been, and that his incompetence should have led to such fatal results. But the object of my writing to you is to point out that in the Province of British Columbia we have no inspector for stationary boilers at all. Of all places this is certainly the one most in need of such an official, for the reason that labor being so high the cheapest man gets the job. The prevalent idea that occurs to steam users as to the qualifications necessary for a boiler and engine attendant, is, that he is able to shovel coal and oil the engine. As to the proportion or pressure of steam to be maintained, the rule is to keep as much of the latter as you can possibly get. To fill the responsible duties of the engineer's position a Chinaman in a number of cases is employed.

I remember on one occasion when working at a battery of six boilers which were fired by a Chinaman, that five of the safety valves were shored from the beams overhead to keep them down tight. This was but one of many such cases.

My reason for writing this letter is obvious: if the people but knew the danger which surrounds them, I think this evil would be remedied.

I not only think an inspector should be provided, but that boiler attendants should be compelled to pass an examination; and to accomplish this, would it be best for the Dominion or the Local Legislature to be asked to pass a Bill to this effect.

Thanking you in anticipation for the space in your valuable journal.

Yours truly,

ENGINEER.

[The Legislature of Ontario is now dealing with this question, and we presume the Local Legislature would be the proper body to remedy the unsatisfactory conditions existing in British Columbia.—ED. E. NEWS.]

The Montreal Water and Power Company has been incorporated with a capital of $2,000,000, for the purpose of constructing and operating water and electric systems throughout the Province of Quebec. Following are the names of the promoters: Messrs. Thomas Joseph Drummond, Alderman Prefontaine, Richard White, George Edward Drummond, James T. McCall, of Montreal; John F. Moffett, Watertown, N. Y.; Emil C. A. Waltmann, John Victor Clarke, George T. Keith, of New York; C. T. Moffett and H. Clarence Hodgkins, of Syracuse, N. Y.

THE ELECTRIC CIRCUIT.*

(Continued from April Number.)

Insulation.—Before proceeding to the practical details of the construction of the various apparatus in use, it will be advisable to devote a short space to the consideration of the most important of all points in connection with electrical engineering, viz., that of insulation. This is the rock that almost invariably wrecks the tyro in electrical matters, and more particularly even the man who, possessing but a slight knowledge of the science, fancies there is no mystery about it.

It will be remembered that it was stated at the beginning of the book that although bodies divided themselves roughly into three groups, which might be termed for convenience, conductors, semi-conductors, and insulators; yet the difference was only one of degree. All bodies conduct, all bodies offer some resistance; and whether a current passes or not, and what current passes, is decided by Ohm's law, no matter what the substance may be.

It has been already pointed out that a long length of fine wire offers a higher resistance than a river, for instance, though the wire is classed as good conductor, and water as a very bad one. It should also be noted that the conducting or insulating properties of *all* bodies vary with their physical condition. Thus dry cotton is a good insulator, wet cotton a very bad one. Dry glazed earthenware or glass are good insulators; the same with a film of moisture condensed on their surface are very bad insulators.

Further, the relative values of different substances as insulators vary with the E.M.F. opposed to them; and also, it must not be forgotten that the electrical resistance of the insulator *through* its substance follows the same law as to length and cross section as conductors, so that a substance which may insulate very well where only a small cross section is exposed to the E.M.F. present, may not do so if the section is large. As, for instance, in the case of two covered wires touching each other outside their covering; if they touch only at one point, the resistance of the insulating material—or the insulation resistance, as it is technically called—is high because the dimensions are small; but if the two wires are twisted, and lie together for some distance, the insulation resistance may be very much less.

A substance that will insulate perfectly in the presence of an E.M.F. of a few Volts, such as are used in telephone and electric bell work, may break down entirely under the strain, say, of 100 volts, the E.M.F. now used in most electric light work. And again, a substance that will answer for 100 volts, may break down under the strain of 2,000 volts, the E.M.F. which the Brush Cos. are using, and which apparently is to be used in town supply.

Again, in the choice of an insulator for any particular work, the electrolytic properties possessed by the current, and which have been already described, must not be overlooked, nor its ability to spark across short distances. A substance that may be a perfect insulator when new—if placed to separate two points or surfaces between which an E.M.F. exists—may gradually break down from the action of the current itself. Remembering, once more, that Ohm's law holds good here as elsewhere, whatever the fraction of an ampère of current may be which the law says shall pass; that current *will* pass, and will do work, and will probably alter the nature of the insulating substance, silently but surely, lowering the resistance of the insulator, till some mechanical action comes into play, such as the sharp edge of an iron plate, or a needle-point left in a casting, and either breaks the insulation down itself, or, by lessening the distance to the nearest point in the wire, provides the conditions necessary for a spark to pass, with practically the same result.

Again, the position of the points or surfaces that are to be insulated, with reference to the rest of the circuit, must be considered. Suppose a certain voltage, say 100 volts, to be present at the ends of the wires of the exciting shunt coils of a dynamo. Let the resistance of the coils be 50 ohms, the current passing in them will be 2 ampères. Now, it will be apparent that we have the full 100 volts present only between the outer ends of the coils. Between the middle and one end we have 50 volts only, because from Ohm's law $E = CR$, $C = 2$ as before, and $R = 25$ ohms. $\therefore E = 50$ volts. So, if the field magnets have four legs each with 12·5 ohms resistance, the E.M.F., or difference of potential existing between the ends of the coils on either leg, is 25 volts only; and this is no question of theory, it may be proved by an actual test with an instrument called a voltmeter, to be described later, or by any of the methods described in the text-books. It is obvious that we may carry this matter as far as we like. Say that there are 25 layers of wire on each leg. Assuming that the wire is uniformly wound, each layer will have a resistance of ·5 ohm, and as the same current passes, *viz.*, 2 ampères, the E.M.F. between any coil and the one above or below it will be 1 volt. Further, if the layer consist of 20 turns, the resistance of each turn will be = ·025 ohm, and the voltage between any two adjacent turns at any point $= \cdot 025 \times 2 = \cdot 05$, or $\frac{1}{20}$ volt.

Thus it will be seen that the E.M.F., or difference of potential, usually present between many points which are in close proximity in coils and other apparatus is very small indeed; and therefore as long as the voltage and insulation remain the same all goes well; but should the insulation of any part be lowered, as by wet, oil, etc., by adjacent coils coming into contact, or by the deterioration of the insulator, the normal strain is increased. Thus, suppose that a quarter of the resistance of the coils of the dynamo magnets before referred to be cut out, say by the ends of the coils of one leg having come into contact with each other, so that the current passes across this path instead of round the coils. Assuming that our E.M.F. remains the same, we have now only 37·5 ohms opposed to the 100 volts and $\frac{100}{37.5} = 2{\cdot}66$ ampères passing, instead of 2 ampères. Our voltage will now be in each leg, $12{\cdot}5 \times 2{\cdot}66 = 33{\cdot}75$ v., instead of 25 volts, and the rest in proportion.

An increase of this magnitude on the present construction of dynamos would probably not be serious, the only thing that would happen being increased heating of the coils that were not cut, and an alteration in the lines of force. But suppose the above figures were multiplied by 20, and the short circuiting of a coil gave rise to an increased voltage of 250 V., between the ends of the coil of one leg, then the matter might be very serious indeed.

The substances used for insulating are, silk and cotton, in places where they will not become wet, as in coils of bells, telegraph and telephone apparatus, dynamos, motors, etc., where also the space available for insulation is small, and the covering cannot easily be subject to mechanical injury. In some cases the cotton or silk is further protected by a coating of some insulating varnish, such as shellac or india-rubber; but it is necessary to avoid all possibility of chemical action between the varnish and the wire, or between the varnish and the covering.

For wires which are exposed to moisture, or that have to stand a certain amount of rough usage, india-rubber, gutta-percha and Callender's pitch compound are used, generally in combination with wrappings or plaits of cotton and tape.

For wires that run overhead, as telephone and telegraph wires, no covering is needed, the air being the very best insulator obtainable, *when it is dry*. For these wires the rests are formed of highly glazed porcelain, or vitreous earthenware, made into special forms, so that the path from the wire to the iron bolt carrying the insulator is as long as possible, and of as small a cross section as possible. Ohm's law comes in again here. With telephone and telegraph apparatus the wire is connected to ground at each end, and a branch circuit will be formed to ground from the wire by way of each insulator and its support, be it a pole or the roof of a house. It will be obvious that the resistance of a single such leakage path will be very high; and that, provided the E.M.F. be low, the leakage current must be very small indeed; and so, on short lines, it usually is. But it will also be apparent that, as the length of the line increases, the number of these leakage paths will increase also, and the leakage current may be a very serious matter.

It is this which makes the problem of telephoning over very long distances so difficult in our humid climate.

Where the E.M.F. is high, as with high tension electric light circuits, the leakage from even a comparatively small number of rests may be serious; but at present the loss by leakage on high-tension electric light circuits carried overhead is inappreciable, because the lengths of the lines are so small. It will be seen later on that the insulation resistance of these electric light

* Walker's "Electricity in Homes and Workshops."

circuits should be kept up for another reason, viz., the safety of the public.

For the insulation of apparatus and parts of apparatus used in electrical engineering, various substances are used. Hard wood, when dry, is a very good insulator for many purposes; wet wood is a very bad insulator for any purpose. Thus, a ringing key at a colliery shaft bottom, if mounted on wood, may work perfectly at first, and fail after a time, owing to the wood becoming saturated with moisture.

Vulcanite—hard, black vulcanized india-rubber—is a first-rate insulator for nearly every purpose, and it does not readily absorb moisture; but it is brittle and expensive, and moisture will condense on its surface. It is unsurpassed for small collars, knobs, etc., designed to insulate two parts of an apparatus between which a high difference of potential exists, yet which must from the construction of the apparatus be close together.

Vulcanized fibre, another substance somewhat similar to vulcanite, is of great service in many places where the brittleness and expense of vulcanite forbid its use. It is tough, and, as its name implies, of a fibrous nature. Its one drawback is, that it absorbs moisture, and then its insulation resistance diminishes very considerably. It must not therefore be used where it will be exposed to damp or oil, except where only a low E.M.F. is present.

The flexible fibre is not a good insulator.

Mica and asbestos are also used for insulation chiefly on account of their non-combustible properties; but they can only be used in certain cases. Asbestos, when worked into mill-board, answers very well for many purposes, such as the insulation of commutator sections, coils of magnets, etc., always provided it can be arranged that the sheet shall not be torn; but it is not a perfect insulator.

The use of mica is more limited. Owing to its peculiar laminated character, you can have a plate of mica of a certain size as thin as you like, but it must be a plate of one thickness all through. It is not workable to section like other substances. It is somewhat brittle too, and it is doubtful if its insulating properties are as high as some people think. Slate and porcelain are now being used for the bases of electric light switches and fuzes; but the former is not a good insulator, and will not answer at all for high E.M.F.s; the latter has the disadvantage that it is difficult to work and is easily broken.

Once more, it must not be forgotten, that in the use of all these substances Ohm's law is the whole arbiter of the fittest, coupled, of course, with the law of dimensions and resistance. Thus, it may be quite practicable to use a comparatively poor insulator in the presence of a low E.M.F., especially if the insulation path is or can be made long and of small cross section, where it would not be if the conditions are reversed.

Induction.—A series of phenomena in connection with electricity that have a very important bearing upon the working of all electrical apparatus, are what are known as electrical induction, or electrical action at a distance.

It has been explained how electrical currents pass through conductors where continuity exists—where continuity does not exist, another series of actions takes place—induced electrostatic charges are formed, and induced currents are generated.

When an electro-static charge is held upon a conductor completely isolated from other conductors, a charge of an opposite name is *induced* upon all other conductors in the neighborhood, that are not insulated.

Again, when a current of electricity passes round a piece of iron, magnetism is *induced* in the latter, and will be rendered visible on closing the magnetic circuit.

When a permanent steel magnet is brought near a piece of iron or steel, magnetism is *induced* in the latter, provided it lies in the path of the magnetic circle.

But the most important phenomena of all are magneto-electric induction, and the induction of currents upon each other.

If a permanent or an electro-magnetic be brought into the neighborhood of a conductor, so that the latter lies at right angles, or nearly so, to the path of the magnetic circuit, or to the lines of force as it is usually expressed in the text-books, an E.M.F. is generated in the conductor, which will give rise to a current, if a path be open for it; and this generation takes place as long as the motion continues, or as long as an alteration in the field in the neighborhood of the conductor is going on. Thus, suddenly exciting an electro-magnet whose magnetic circuit crosses a conductor, will generate an E.M.F. in the latter. Suddenly causing an electro-magnet to lose its magnetism will have a similar effect; but the E.M.F. in the former case will be in the reverse direction to that in the latter; that is, it will tend to produce a current in the opposite direction through the electric conductor. Varying the strength of an electro-magnet will have the same effects, though in a minor degree, as suddenly magnetizing it or causing it to lose its magnetism.

Upon the phenomena of induction the dynamo electric machine, the induction coil, and the transformer have been reared.

The property of inducing currents also extends to wires in the neighborhood of other wires. If, for instance, a second wire be wrapped round an electro-magnet, in addition to the exciting wire; each time that the exciting circuit is closed, an E.M.F. will be generated in the second wire; and each time the exciting circuit is broken, an E.M.F. will be generated in the second or secondary wire, as it is usually termed, the exciting wire being called the primary; but the direction of the E.M.F. generated in the two cases will be opposite to each other.

A variation in the strength of the current passing in the primary or exciting wire is also followed by a generation of E.M.F. in the secondary, though in a minor degree.

The directions of the secondary E.M.F.s are always such as to resist the action of the primary current. Thus, the current which passes in the secondary when the primary circuit is closed, is in the opposite direction to that passing in the primary; that which is generated in the secondary when the primary circuit is broken, is in the *same* direction as the current that was passing in the former.

Similarly, weakening the primary current generates a current in the secondary in the same direction as that which is passing in itself. Strengthening the primary has the reverse effect.

It is not necessary even for two wires to be together on an electro-magnet for induction to take place. Suddenly making or breaking the exciting circuit of an electro-magnet, generates opposing E.M.F.s within the coils of the exciting wire itself; that when it is made opposing the current, and that when it is broken assisting it. The latter has been known as the *extra* current, having been so named by Faraday, to whom we are indebted for so many researches upon electro-magnetic induction. It is the *extra* current that gives such a smart and often fatal shock, when the circuit of a high-tension electric light machine is broken; the coils on the field magnets of the dynamo generating, by induction, a very much higher E.M.F. than the working E.M.F. of the machine.

The secondary E.M.F. generated in all these cases depends upon the primary E.M.F., the number of coils taking part in the induction; or, what amounts to the same thing, the lengths of the wires exposed to induction; upon the speed of motion where one or both bodies move; and inversely upon the distance between the exciting and secondary apparatus.

It must be remembered, however, that in all these cases induction only takes place while motion is proceeding, or changes of magnetism are taking place, and the currents generated are therefore usually only of very short duration.

But it is not even necessary that iron should be present for induction to take place. If two wires be near each other and parallel; when a current passes in one, an E.M.F. is induced in the other at the moment the first starts and at the moment the first ceases, and these two are in opposite directions, and obey the same rule as before, viz., the secondary current is in the opposite direction to the primary, when the latter commences, and in the same direction as the primary when the latter ceases.

A variation in the current passing in one wire also gives rise to induced E.M.F.s in the other, just as in the case of the electro-magnet, with two wires wound on it.

The induction in the case of two wires also follows the same rule as to distance apart, and to the lengths of wire exposed to induction. The induction, for instance, between two telephone or telegraph wires running parallel for several miles, and within a few inches of each other, as on ordinary telegraph poles, will be very great; while that between wires separated by the width of a street, or only running together for a short distance, may be inappreciable.

The reason for E.M.F.s being generated in conductors under the conditions named, is evidently due to their passing through the magnetic circuit, or, as it is usually termed, cutting the lines of force. Where an electro-magnet is excited, a magnetic field, a magnetic circuit, or magnetic lines of force, whichever term be preferred, is created, and the secondary wire lying in their path, an E.M.F. is generated in it. The converse takes place when the primary circuit is broken, and this applies to all cases of electro-magnetic induction. A magnetic circuit is either created, broken, or varied, and in each conductor lying in the path of the circuit, an E.M.F. is generated.

From the above it naturally follows, that in conductors which run parallel to the directions of lines of force, no E.M.F. is generated, and so it happens that no induction takes place between two wires crossing each other at right angles.

For effective induction, where the secondary current is to be used apart from primary, as in induction coils used for experimental purposes, for telephone transmitters, for the transformers now being introduced into electric lighting, the primary and secondary coils must be insulated from each other, and the insulation should be proportionate to the E.M.F.s generated. With induction coils, by wrapping a long length of secondary wire round a shorter length of primary, it is possible to generate very high E.M.F.s in the former, using only very low E.M.F.s in the latter; each coil of the secondary that is brought within the influence of the lines of force adding to the E.M.F.s generated. Where high E.M.F.s are generated, and used for the purposes of electric light distribution, being converted into low E.M.F.s at the point of consumption, great care must be taken to insulate fully between the coils, or the inductive action will be destroyed to a large extent, and may give rise to serious accidents.

But though, where it is desired to use electrical induction as a servant, it is necessary to insulate the two coils from each other, induction will take place nevertheless without any insulation. One case has been given, where the coils of an electro-magnet generate an E.M.F. by acting inductively on each other; coils even are not necessary for induction. But it will take place within a wire itself.

Each portion of a conductor acts as a separate wire. Thus, a copper rod half an inch in diameter may be taken to consist of a number of small wires all grouped round a centre; and as apparently the first action of a current is mainly confined to the surface of a conductor, induction takes place between the outer wires, so to speak, and the inner, giving rise to many puzzling phenomena in connection with dynamo construction, and with lightning discharges; about which something will probably be said later on, Prof. Oliver Lodge's recent investigations having considerably modified our ideas with regard to the latter.

ELECTRIC CRANES.*

By Reginald Bolton.

THE use of hoisting machinery forms a subject of interest to many engineers, while the question of its economies is of even deeper interest to all those engaged in the transport or movement of materials. The application of electricity to this particular purpose is one that at first sight may not present great apparent advantage, but a consideration of the conditions to be fulfilled will, on the contrary, show that there is no more suitable conjunction of force and duty, and even at the present stage, no purchaser of hoisting machinery can afford to disregard the claims of the conveyance of power by electricity, for reasons which the author hopes, succintly, to show.

There are three considerations which present themselves, and which, if answered affirmatively, cover the whole subject.

Naturally, the primary one is,

1. Its comparative economy.

The second in order is,

2. Its superior merits.

The only remaining consideration being,

3. Its practicability.

Under the first we have to look into a few of the figures of electric and steam motors on cranes.

Now, an electric motor is in itself a most economical transmitter of power, its efficiency running as high as 90 per cent. in regular work, and if worked under proper conditions, its life may be as long as that of any ordinary steam engine, while under the special safeguards designed by the author its durability would be far more prolonged. But the power must necessarily be generated and conveyed to this motor, and so the question of the economy of the generating dynamo and the power that drives it comes into question. Such directly-connected engines and dynamos as are used on board ship, and in numerous central-station installations on land, have repeatedly given a united efficiency of over 80 per cent. of the horse-power of the steam in the cylinder.

There are a far greater number of cases, however, where such a dynamo would receive its motion direct from a shaft driven by a larger engine, and in such a case an even superior result might be relied upon. It would, in fact, be safe to assume an output of 85 per cent. of the actual power put on to the dynamo pulley, in the shape of electrical force, and as, in the case of shop cranes, or wharf cranes, they would not be remotely situated from the generating dynamo, the loss in transmission would be small and can be stated at 1 per cent. to 2 per cent. only.

In the case of a large dock, with cranes situated at all parts, there would be greater distances to be dealt with, but even these would not exceed the limits of ordinary low-tension circuits, and the system would show a very favorable comparison in losses by transmission, as against the distribution of hydraulic power.

For all ordinary conditions, then, we may deal with the following figures:

One h. p. put into dynamo results in	.85	of 1 h. p.
Less by loss in transmission two per cent............	.00085	of "
Leaving the force put into motor as..................	.[illegible]415	of a h. p
Output of motor 90 per cent. =	.7573	of 1 h. p

Or a total loss of less than 25 per cent.

Now take the comparative case of a steam driven crane, say of two tons power, having two cylinders each 5½ in. diameter by 8 in. stroke, running at 150 revolutions per minute. Such engines are on full work linked up to cut off steam as late as ⅝ to ¾ of the stroke, and thus exhaust their steam at a considerable pressure. The usual boiler pressure is 70 lbs., maintained at an average of about 65 lbs., and wire drawn by pipes and connections to, say, 60 lbs. initial pressure. Under above conditions they indicate about 14½ horse-power, but their consumption of steam is very considerable, and cannot be assumed at less than 35 lbs. per horse-power per hour. An excellent authority gave, recently, instances of such small high-speed engines absorbing over 40 lbs. per horse power per hour. The net efficiency is still further reduced by the internal friction of the machines, which even in good engines would average 15 per cent., so that we arrive at a final efficiency of these engines used as motors on cranes of not more than 60 per cent.

On all small steam cranes, however, there is a further waste in the boilers, which, being small and of the vertical type, are far from economical in raising steam, and habitually consume 5 to 7 lbs. of fuel per horse-power per hour. In practice no crane is ever continually at work, and during the periods of lowering, changing gear and stops, &c., the fuel continues to burn, and there is also the cost of fuel and labor of raising steam in the morning for the day's work.

It is customary among crane builders to construct the boilers of steam cranes a good deal smaller than would be necessary if the engines were in constant running; the gain in pressure during the stops and changes mentioned compensating the loss of pressure during working, and the steam gauge is consequently constantly on the move. Now, against these figures we should have, in the case of a direct-driven dynamo, a better engine running with an earlier cut-off, and also necessary steam more economically raised. The motor when the crane is standing wastes no power, and the dynamo may be shut down or started at short notice. The crane driver need pay no attention to the crane when standing idle, and he starts without delay in the morning, the power being derived from the shop boilers. There would thus appear to be a very decided economy in favor of electric cranes, as against steam-driven machines. In the case of overhead travellers, there is the saving due to the absence of long square shafts running in movable bearings, and which, together with the cotton or wire ropes in rope-driven cranes, are kept constantly running even when the crane is out of use.

Lines of force that have the same direction repel each other, while if they have opposite directions they attract each other.

*Abstract of a Paper read before the Civil and Mechanical Engineers Society, February 18, 1891.

NOTES.

A two-shell type of boiler is giving considerable promise under experiment in England, withstanding, so it is said, greatly increased pressure. This is a boiler recently designed to work with safety under a pressure of 250 pounds, consists of an inner shell capable of enduring 150, surrounded by a shell, the safe working pressure of which was 100. Reducing valves allow sufficient steam to pass from the inner boiler to the space between the shells to maintain the required pressure, and the inner shell is thus subjected to an unbalanced pressure of only 150 pounds, although containing steam at 250. Each compartment contains safety valves, and is carefully tested before using.

It is well known that vegetable and animal oils are unsuitable for cylinder lubrication. In an article on the subject in the *Portfeuille Economique des Machines* M. Recour states that when colza oil was used on the railway with which he was connected, it was necessary to burn out the deposit in the ports of the locomotive cylinders after the engine had run 18,000 miles. At the end of a year's service this deposit was from .06 in. to .08 in. thick on the piston faces, and from 1-10 in. to ⅛ in. thick on the covers and steam ports. In the exhaust ports the thickness of deposit was as much as .27 in. to .35 in. On analysis the deposits proved to consist of carbonaceous matter from the decomposition of the oil, and of the oxides of iron and copper due to the wear of the valve and cylinder surfaces. When tested in the laboratory at temperatures 212° to 536° Fah., it was found that colza oil first absorbed oxygen, then gave off hydrogen, and finally broke up into oleic and stearic acid with the separation of glycerine.

A cheap non-conducting coating for steam pipes, etc., said to have been used with perfect satisfaction by a Boulogne engineering firm, is described in a recent issue of the *Revue Industrielle*. It consists of a mixture of wood sawdust with common starch, used in a state of thick paste. If the surfaces to be covered are well cleaned from all trace of grease, the adherence of the paste is perfect for either cast or wrought iron; and a thickness of 25 m m. will produce the same effect as that of the most costly non-conductors. For copper pipes there should be used a priming coat or two of potter's clay, mixed thin with water and laid on with a brush. The sawdust is sifted to remove too large pieces, and mixed with very thin starch. A mixture of two-thirds of wheat starch with one-third of rye starch is the best for this purpose. It is common practice to wind string spirally round the pipes to be treated, keeping the spirals one centimeter apart to secure adhesion for the first coat which is about 5 m m. thick. When this is set, a second and third coat are successfully applied, and so on until required thickness is attained. When it is all dry, two or three coats of coal tar, applied with a brush, will protect it from the weather.

There are a great many people using incandescent lamps says *Modern Light and Heat*, who are wont to complain that the lamps are not satisfactory in their operation; they burn too few hours, or do not give light enough, or the globe soon becomes blackened. Such are some of the objections put forth, and which to our knowledge, in several cases, have caused a change in the make of a lamp, which has given no better results, simply because the fault to a certain extent has been with the user and not with the lamp itself. There is nothing which kills a lamp quicker than operating it at too high a voltage, and owners of isolated plants are often prone to do this. It is, moreover, poor economy; for if more light is required, it would be cheaper in the long run to install more lamps and run them at the proper voltage. We have seen installations, too, where dust and dirt were both too familiar friends with the incandescent lamp and where improper shades were absorbing twenty per cent. of the light. If users of incandescent lamps would first run their lamps at a proper voltage, and then see that the glass is kept perfectly clean and free from dust and dirt, and that they are supplied with proper shades, there will be better results and less cause for complaint.

The Edmonton *Bulletin* thus refers to deposits of platinum existing in the Saskatchewan district in the Canadian Northwest. The price of platinum has risen steadily during the past few years, especially since the advent of the electric light, in the production of which it is found to be an absolute necessity. The market price in London is now $20 an ounce. In each 16 candle power light there are from four to eight grains of platinum. If six grains are taken as an average an ounce will be used in eighty lamps. Based on the increased use of incandescent lights within the last two years it is safe to say that the demand for 16 candle power lamps or their equivalent in the present year will reach 10,000,000. This means a demand for 125,000 ounces of platinum, worth at the present price over $2,000,000. The supply is mostly drawn from mines in the Ural Mountains of Russia. Platinum is found in the Saskatchewan in connection with gold, with which it is frequently secured and sometimes adulterated. At present prices it would pay our miners to give more attention to this increasingly valuable metal, not only as a matter of present profit, but also with a view of the possibility that although the fountain head of the gold has as yet eluded discovery, the platinum might lead to the source of both these now equally precious metals.

Many suggestions have been made for remedying the vibration and noise attendant on the working of the big engines which are employed to run dynamos. A plan which has given great satisfaction is to build hair felt into the foundations of the engine. An electric company has just had one of its ninety horse power engines removed from its foundations, which were then taken up to the depth of four feet. A layer of felt five inches thick was then placed on the foundations and run up two feet on all sides, and on the top of this the brickwork was built up. The cost of the alterations was about $300.

SPARKS.

A single line of force, or unit, is that amount of magnetism which passes through every square centimetre of cross section of a magnetic field whose intensity is unity.

The Belleville gas company's works and electric plant have been leased for ten years by Mr. Pearson, of Toronto, who is to pay 6 per cent. on the capital of $80,000 and 6½ per cent. on a mortgage of about $40,000.

The volts in the shunt dynamo fall, whilst those in the series rise as the current rises. By employing compound winding, the mean of the two effects is obtained, and the volts can be kept practically constant over a wide range, without change of speed.

The Ottawa Electric Street Railway Co. has been organized as follows: President, J. W. McRae; vice-president, Geo. P. Brophy; treasurer, Wm. Scott, secretary, D. C. Dewar. The secretary reports that about three-fourths of the stock of the company has been subscribed.

Mr. Mackintosh, M. P., is at the head of an Ottawa syndicate which is seeking incorporation under the name of the "Anglo-Canadian Electric Storage and Supply Co.," for the purpose of manufacturing, selling and leasing secondary batteries and all kinds of electric supplies and appliances.

The business and plant of the Hamilton Electric Light Co. was purchased at auction on the 19th inst., by Toronto and Hamilton capitalists for the sum of $92,000. The Toronto members of the new company are directors of the Toronto Electric Light Co. The Hamilton members are Messrs. J. M. Lottridge, R. Æ. Kennedy, J. V. Teetzel, Robert Thomson and D. R. Dewey. It is stated that $50,000 will be spent in improving the service and establishing an elaborate incandescent lighting system.

In interior wiring for incandescent lamps, particular attention should be paid to fuse boxes, and especially to the quality of the fuse wire. This is made of such varying composition that scarcely two makes act in a similar manner. Some samples possess good conductivity and are slow in heating, while others fuse readily not only causing the annoyance of frequent replacement, but offering the temptation to careless workmen to use too heavy a fuse wire or substitute copper wire,—a most pernicious practice and destroying at once the protective properties of the fuse box. —*Modern Light and Heat.*

SPARKS.

The Fort Wayne Electric Co. has been given the contract for lighting the city of St. Thomas.

A Bill has passed the Legislature enlarging the powers of the Mimico Electric Railway and Light Co.

Dr. Knight has been delivering a series of instructive lectures on electricity at the night school classes for workingmen at Kingston, Ont.

The Perth Electric Light Co. have purchased a 540 light incandescent plant, and will in future operate both arc and incandescent systems.

At the Government printing bureau at Ottawa there has lately been installed an incandescent plant supplying 1,100 lights. This is the largest isolated incandescent plant in the Dominion.

The Port Hope Electric Co. have been unfortunate by reason of the occurrence of several accidents on their premises. It is gratifying to learn, however, that affairs are now running smoothly with them.

The St. Catharines Electric Street Railway, owing to the financial embarrassment of the proprietor, has passed under the control of the Bank of Toronto, and is being operated under the management of Mr. Thos. Nihas.

In the Bill authorizing the amalgamation of the Kingston gas and electric companies, the charter of the new concern has been limited to twenty years, at the end of which period the city is given the privilege of acquiring the plant.

The manager of the Hamilton Electric Light Co. states that the manufacturers of electric globes in Canada charge 50 per cent. higher prices than those prevailing in the United States; consequently American globes are being purchased.

Toronto Central Division No. 123, of the order of Railway Telegraphers, was organized a few weeks ago with the object of raising the standard of the profession. Delegates were appointed to attend the annual convention of the order at St. Louis, in June.

The Bell Telephone Co.'s new building at Hamilton is to be ready for occupation early in July. It will contain a new multiple switchboard capable of accommodating 3,000 subscribers. It is said to be the intention to reduce the present rates to small consumers.

A Pembroke lunatic started out to shoot a citizen of that town the other day for the alleged offence of exercising undue influence upon him by means of a galvanic battery or other electric apparatus. The would-be murderer was "switched off" to the county jail.

Mr. A. E. Elliott has succeeded Mr. Geo. E. Bander as manager of the electric street railway at Vancouver, B.C. The retiring manager, prior to leaving for Seattle to enter upon the duties of a new position, was presented with an easy chair, scarf pin and complimentary address by the employees of the company.

Mr. Tait has introduced a measure in the Ontario Legislature authorizing municipal councils to compel telephone, telegraph, electric light and other corporations stringing overhead wires to place their wires in cables; also to compel such companies to allow other wires to be strung on their poles, subject to payment of a reasonable rent, such rent, in the event of dispute, to be fixed by an electrical expert to be appointed by the Commissioner of Public Works.