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NEW SERIES, VOL. VIII.—No. 8.

AUGUST, 1898

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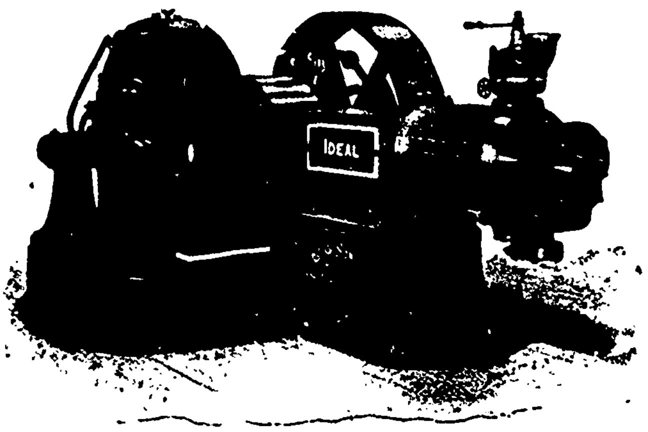

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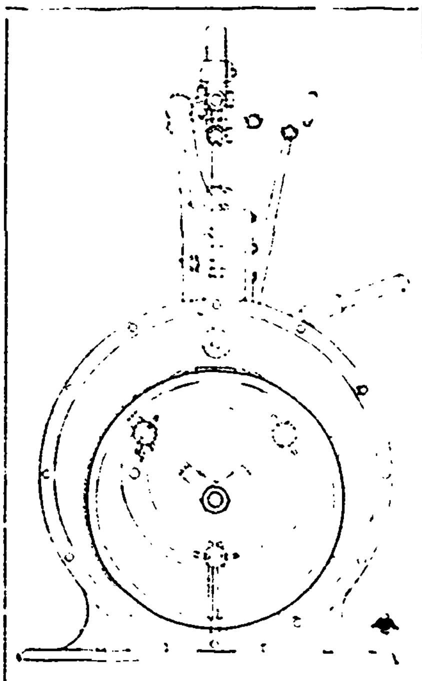

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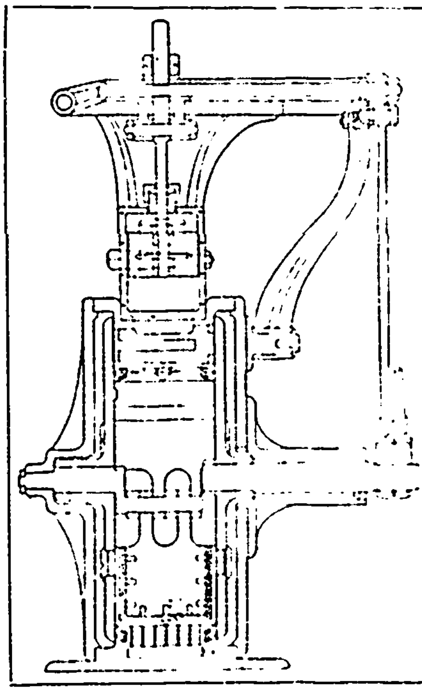


CANADIAN

ELECTRICAL NEWS

AND

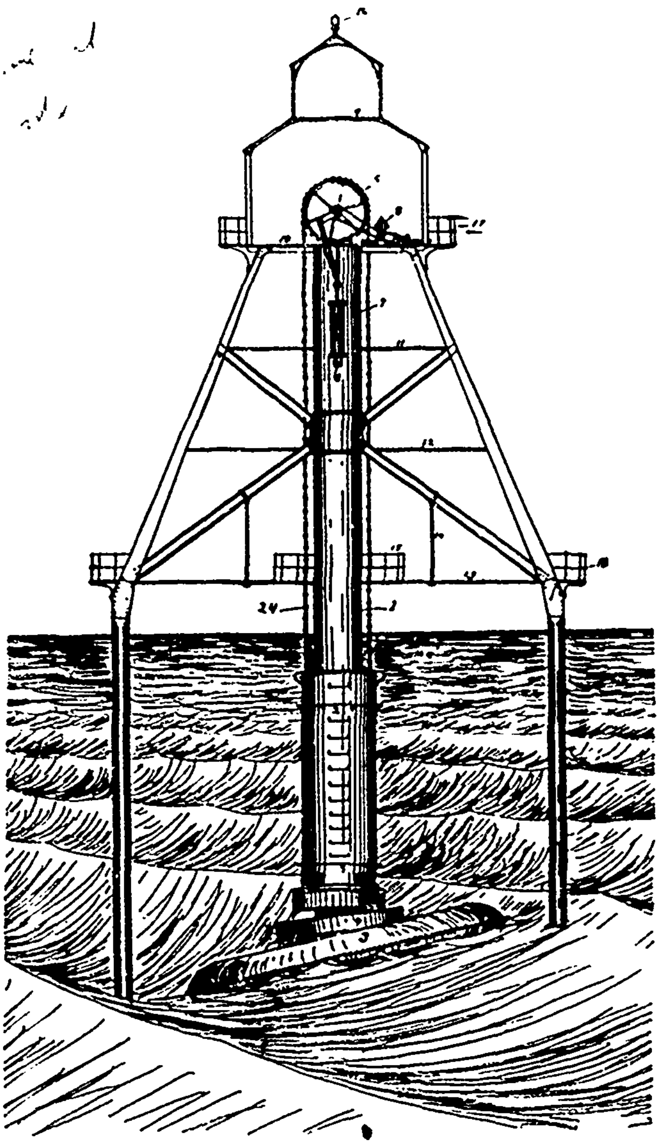
STEAM ENGINEERING JOURNAL.

VOL. VIII. AUGUST, 1898 No. 8.

WAVE MOTOR.

MR. Edward J. Ryan, of Milltown, Charlotte county, New Brunswick, has sent the ELECTRICAL NEWS drawings of a wave motor of which he is the inventor, and which he believes embodies many points of merit. The principle of the motor will be understood by reference to the accompanying illustrations, regarding which the inventor writes as follows :

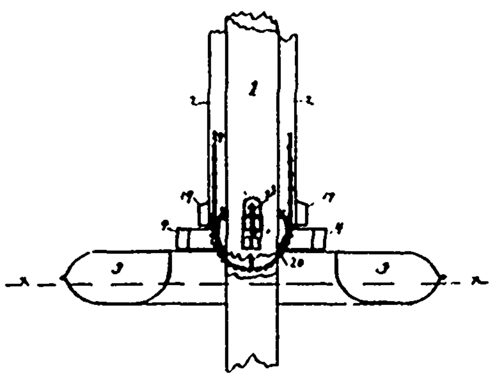
Fig. 1 is a sectional view of the structure above water



WAVE MOTOR—FIG. 1.

surface. 1, central stationary tube ; 2, truck tube ; 3, float ; 4, hoop ; 5, upper sprocket wheel ; 6, compressed air pump (there is another pump directly on other side of air tank) ; 7, air tank ; 8, pressure govern device ; 9, light room floor ; 10, floor on which one or more dynamos may be placed ; 11, pump and engine room floor ; 12, space on which dynamos can be placed, and to be used by the operators for their living apartments ; 13, lower floor ; 14, hanging rods to support centre of lower floor ; 15, rail circling opening in lower floor ; 16, fog whistle ; 17, upper promenade ; 18, lower promenade ; 24, endless sprocket chain.

Fig. 2 is a sectional view showing lower sprocket wheel. It will be seen that the truck tube, 2, will play

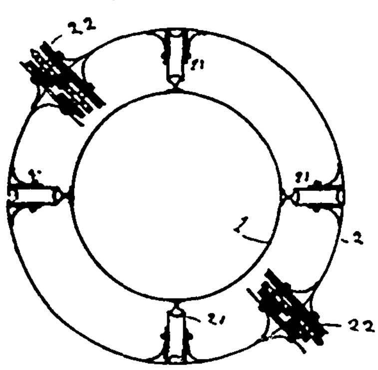


WAVE MOTOR—FIG. 2.

down by the lower sprocket wheel. 1 is stationary central tube ; 2, truck tube ; 3, section of float (x-x, water surface) ; 4, section of hoop ; 19, base section of truck tube ; 23, screw attached to lower sprocket wheel shaft bearings, to lift and lower the same ; 24, endless sprocket chain.

Fig. 3 is a top plan sectional view, showing the method of reducing friction of truck tube as it plays up and down on central stationary tube. 1 is central tube ; 2, shell of truck tube ; 21, rollers and rail ; 22, chain gripping devices.

Fig. 4 is a chain grip device, to grip the chain on the upward motion. These devices consist of a sprocket and a roller, between which the chain passes. The sprocket tooth passes through the chain and enters a recess in the roller, so the chain cannot slip. The

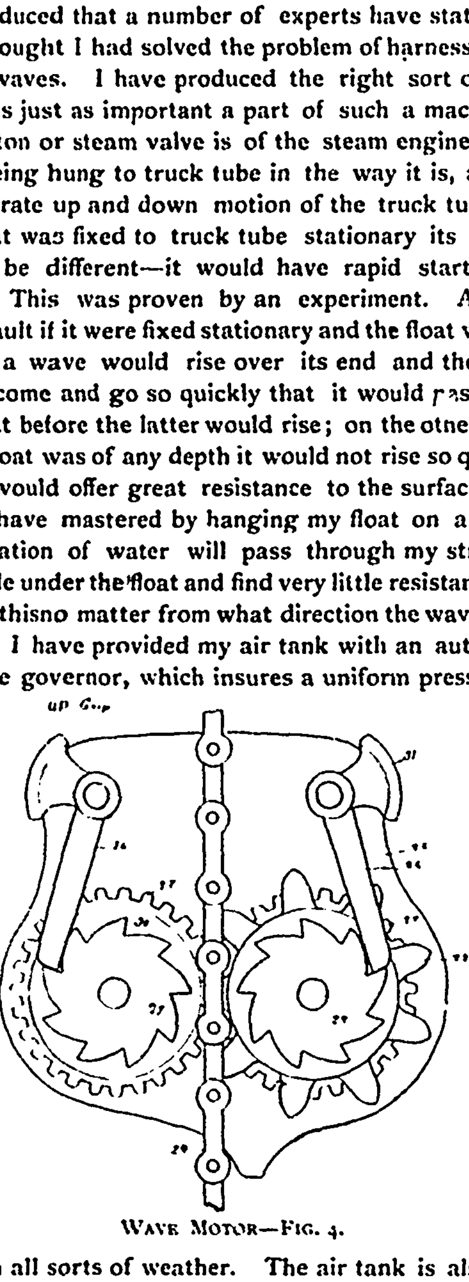


WAVE MOTOR—FIG. 3.

sprocket and roller shafts are provided with a cog wheel, which mesh together so that sprocket and roller will always turn together ; on the same shafts are placed a ratchet wheel, the same being provided with dogs. When these dogs are in position and the device is carried up, the chain must go with it, and when it descends the sprocket and roller will run down on the chain and offer no resistance to it. When it is necessary to stop the chain, all that is required is to lift and throw back the ratchet dogs, and the device will offer no resistance to the chain either on the up or down motion. 24 is endless chain; 25, case plate; 26, ratchet dogs; 27, cog wheels; 28, sprocket wheel; 29, ratchet wheels; 30, roller; 31, weight on ratchet dogs.

Fig. 5 is view of down grip. This is just the same as the up grip, only the ratchet wheels and their dogs are placed in the opposite position. When the up grip has gripped and is carrying up the chain on one side, the chain is being drawn down on the other, and the down grip will offer no resistance to the chain. When the down grip has gripped and is carrying down the chain, the same is being drawn up on the other side, and the up grip will offer no resistance to the chain.

The machine is so different in construction from any yet produced that a number of experts have stated that they thought I had solved the problem of harnessing the ocean waves. I have produced the right sort of float, which is just as important a part of such a machine as the piston or steam valve is of the steam engine. The float being hung to truck tube in the way it is, assures a moderate up and down motion of the truck tube. If the float was fixed to truck tube stationary its motion would be different—it would have rapid starts very often. This was proven by an experiment. Another great fault if it were fixed stationary and the float was flat is that a wave would rise over its end and the same would come and go so quickly that it would pass over the float before the latter would rise; on the other hand, if the float was of any depth it would not rise so quickly, and it would offer great resistance to the surface. All this I have mastered by hanging my float on a pivot; an elevation of water will pass through my structure and slide under the float and find very little resistance. It will do thisno matter from what direction the waves may come. I have provided my air tank with an automatic pressure governor, which insures a uniform pressure in

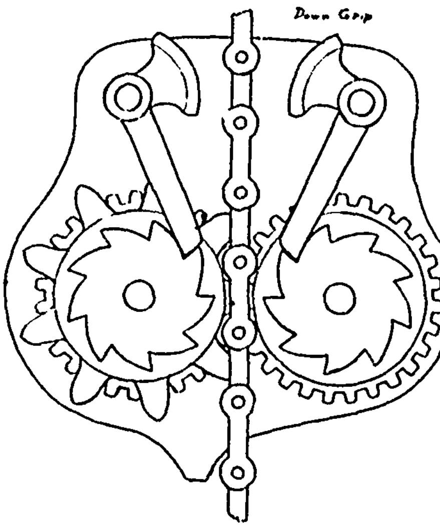


Wave Motor—Fig. 4.

tank in all sorts of weather. The air tank is also provided with a safety valve.

I see in the Electrical News that Mr. Wm. Cross thinks that Thos. A. Edison, jr., got his idea to harness wave motion from him. Now, I think that Edison's machine is no more like Mr. Cross's invention than day is like night. I would say that Edison's machine is more like my own than any other, and permit me to say through your columns that if Edison has copied from any person's machine it has been from mine, as you can judge from the following:

On the 19th day of October, 1897, I wrote, and sent a sketch showing the outside of my structure, to Mr. Thomas A. Edison, offering to send the detail drawings and to give him a half interest in the patent if he would furnish the capital to secure the same. I gave him no information of my working gear, but informed him of the one great tube running down through the centre of the structure. He returned my sketch after a time, and told me that he was so busy that he had no opportunity to look into the subject. Now, in the New York



Wave Motor—Fig. 5.

Journal of January 14, 1898, there appeared the drawings and description of a wave motor, of which Mr. Thos. A. Edison, jr., was said to be the inventor, and it will be remembered that it stated that the development of the details of the plan was the work of a few months in the young wizard's mind. His motor consists of one great pump, the piston rod of which is connected direct to a float. It looks, without a doubt, that the Edisons thought that my central stationary tube was one great pump cylinder, and it also appears as though the young wizard found a little time to look into the subject.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By Wm. Thomson.

(Article 7).

Another commonly met compound of a similar type is one containing large percentages of caustic alkalies, usually crude caustic soda. The reaction between sulphate of lime held in solution and caustic soda is similar to reactions already cited.

Sulphate of Lime.		Caustic Soda.		Calcium Hydro-Oxide. (Lime)		Sulphate of Soda.
$CaSO_4$	+	$2NaOH$	=	$Ca(OH)_2$	+	Na_2SO_4

A similar reaction sets up between carbonate of lime and caustic soda. Water within the boiler soon becomes strongly alkaline and attacks brass and composite fittings very vigorously, also is very prone to foam; particularly is this the case if any saponifiable oil finds its way to the boilers. Compounds containing quantities of caustic soda in the absence of neutralizing agents can be with safety avoided.

Innumerable compounds have been introduced on the market containing organic acids, and some of these have good properties to recommend them. Chief among these are compounds containing "tannin" or tannic acid. Roger's process for the prevention of formation of scale consists essentially in the use of sodium tannate, which is a very useful reagent when properly made and applied. A reaction sets in between carbonate of lime and sodium tannate whereby insoluble amorphous tannate of lime is precipitated and sodium carbonate is formed, which in time acts upon any sulphate of lime present, reducing it to a carbonate of lime, thus leaving it in a position to be acted upon by a fresh supply of sodium tannate. Such reactions as these have sound chemical reasoning to recommend them. Care should be taken, however, that an excess of acid is not present in the solution, or damage to the boiler will occur. If sodium tannate is at all pure and made by trained chemists the reaction should always leave sufficient alkali present within the boiler to counteract the injurious effect of free tannic acid.

It will be seen from the foregoing that boiler feed waters are subject to a wide range of impurities and in widely apart quantities, so much so that the use of no single boiler compound can be relied on to attain satisfactory results. Each particular case must have individual attention. Where methods of this kind have been adopted and practical experience has been brought to bear on the

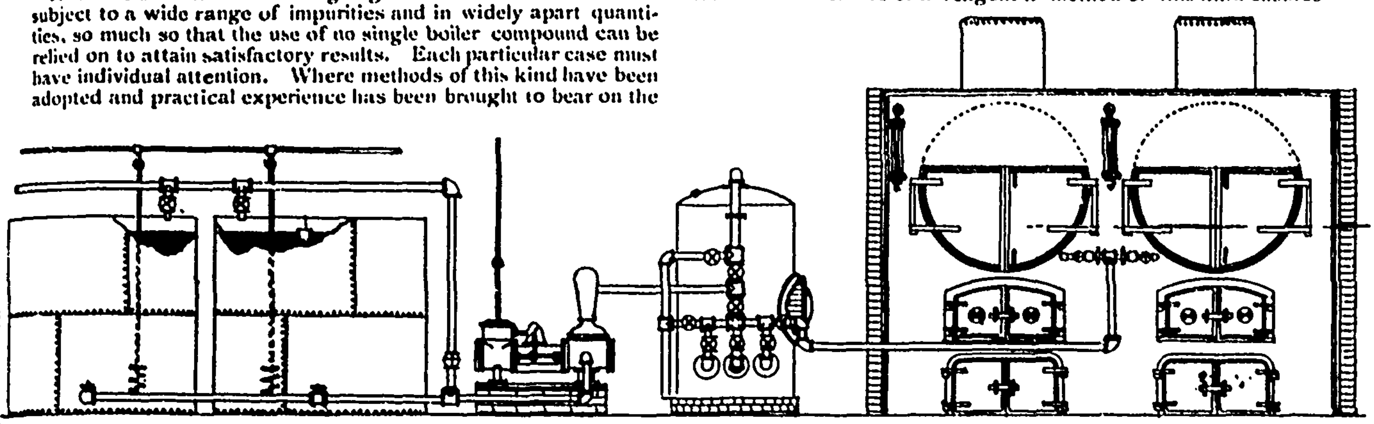


FIG. 1.

subject, wonderful success has been attained. This is evidenced by the almost remarkable success that has been attained by such men as Geo. W. Lord, whose compounds to-day stand so high in the annals of steam engineering that genuine compounds bearing this name are now accepted without question.

Treatment by chemicals aims to precipitate scale forming material as an insoluble, unhardenable sludge which can be easily separated from the water.

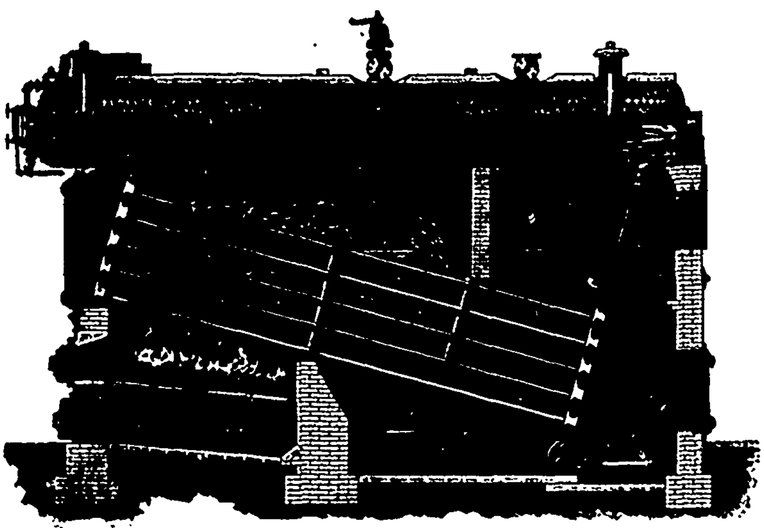


FIG. 2.

This method has very serious drawbacks, inasmuch as precipitation takes place within the boiler itself, and a thick pasty mass is liable to form directly over the fire box in certain styles of boilers of such a nature as to be quite as dangerous as the formation of the scale itself. We can then readily see that a successful method of dealing with scale forming waters demands both chemical and mechanical treatment—chemical treatment to precipitate scale forming agents, and mechanical treatment to extract this precipitate previous to delivering water to the boilers.

Every plant that makes any attempt at economy is provided with some means of heating feed water previous to delivering to boiler. The effect of this heater is to bring about a physical and chemical change on certain of the impurities contained by the water, and the presence of heat tends to aid precipitation and hasten the action of reagents; consequently all compounds should be fed into water gradually in sufficient quantity (previously determined) previous to water entering heater, when action will set in. Many of the manufacturers claim to extract the whole of the impurities at the heater by the simple addition of heat, while they are enabled, if a sufficiently high temperature can be reached, to cause precipitation of impurities. It is not quite as clear that this precipitate can be at once separated. Usually this precipitate passes over with the water to the boiler and is of an extremely fine nature whether chemical or physical means have been chosen to bring about precipitation. To prevent this a filtering arrangement, as shown in Fig. 1, is to be recommended.

This arrangement is intended to use two tanks of required capacity into which a definite quantity of reagent has been added and the whole is heated to about 212° Fah, water being fed from each tank alternately to boilers, sufficient time being allowed to lapse to complete chemical reaction before water is passed through filter intervening between tank and boiler. While these tanks are a distinct aid to the efficient working of the filter, they are by no means an absolute necessity. Water could be passed directly from heater to pumps, thence through filter to boiler. With care in choice of a reagent a method of this kind ensures clean boilers and successful treatment of waters otherwise unfit for boiler feed purposes.

Since, however, in bad waters filter is liable to be given a great deal of work, it is absolutely necessary that sure and quick methods for cleaning of filters are provided, and engineer requires to fully satisfy himself on this point before undertaking installation of a purifying plant on this principle.

In waters liable to throw down heavy precipitates in the absence of a filtering medium, or in small plants where capital investment becomes excessive for filtering apparatus, great care should be exercised in the choice of boilers. Construction should be such that all precipitates will deposit on lowest and coolest part of boiler at a point easily accessible and easily blown out. (See Fig. 2.)

This shows a type of boiler constructed with a view of securing precipitation of scale-forming impurities before water comes into actual contact with flues and plates of boiler exposed to high temperatures. Water containing the bi-carbonates of lime or magnesia or other salts that simply require heat to cause change of state from soluble to insoluble salts, being fed into the upper portion of boiler or portion used for steam drum, separation and precipitation would take place gravitating to lowest point or immediately behind baffle plate in front end of boiler, where blow-off is situated.

A type of boiler that has in the writer's experience given excellent satisfaction in this respect is illustrated in Fig. No. 3.

It will be noted that mud drum is provided at lowest point in this boiler, and placed in such a position that no actual contact with high temperature gases can occur; when waters have been treated as suggested, precipitate will follow current to lowest point and then settle. In this case mud drum acts as a receptacle for this precipitate, and being arranged in form indicated by cut, sludge or precipitate is concentrated in ready form for blowing out, and it has been the writer's privilege to have examined boilers of this type using waters that had been treated with chemical compounds and blow-off opened for a short time as occasion required to get rid of sludge, that were practically clean, although they had been in almost continuous use for nearly four months.

Both these boilers show distinctive types of mechanical arrangement designed to assist the water chemist in his work, and in closing these articles I wish to add my quota of thanks to the mechanical genius that enables this important question to be dealt with so successfully.

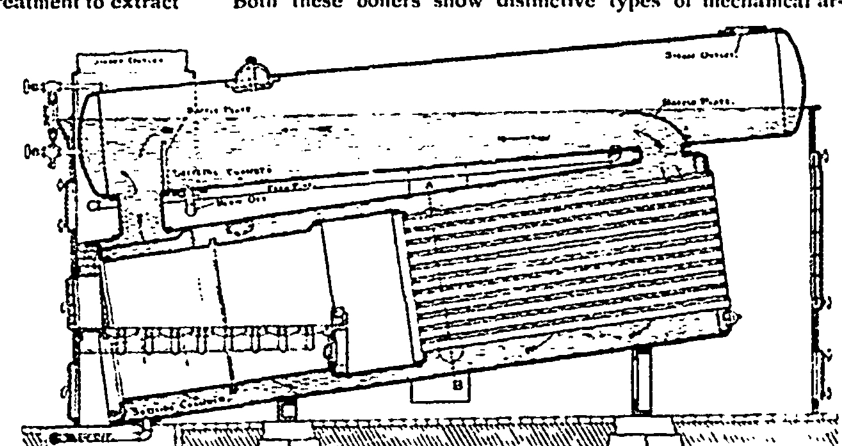


FIG. 3.

Mr. J. Walls, electrician, of Toronto, will have charge of the electric plant at Goldstream, B. C.

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Boiler Explosion at Sycamore.

THE recent boiler explosion in a sawmill at Sycamore, Ont., by which the lives of four men were sacrificed, again emphasizes the necessity of compulsory inspection of boilers, and of having reliable engineers in charge of same. That public opinion is growing in this direction is shown by the recommendation of the coroner's jury that boiler inspectors be appointed and that engineers be compelled to hold certificates of competency. The jury, in their report, state that the explosion was caused by the pressure on the boiler being too great, which may be interpreted to mean that the accident might have been avoided by the exercise of more precaution and skill. In view of the number of explosions similar to that referred to above, the legislation which the Canadian Association of Stationary Engineers is seeking to obtain should, in the public interest, be heartily supported.

The Freight Transportation Problem.

REFERRING to the tramway paper presented by Mr. W. T. Bonner before the Canadian Electrical Association, the Electrical Engineer, of New York, says: "We are interested to note that at the recent meeting of the Canadian Electrical Association, serious attention was drawn to a plan for the standardization of farm wagons in such a way that they could be taken aboard bodily by trolley trucks and thus hauled to and from market. At first blush this looks like a rather wild project, but we confess we can see no good reason why some such plan should not be carried out in every rural region now tapped by a trolley service. The lessening of the cost for haulage and of loss from spoilage would be enormous; the trolley would open up a new country and a new source of income; the rates would be so low as to encourage the development of new lines of cultivation, and the ties between town and country would be more closely knit than ever. These things will come and must come soon, with electricity as the prime factor in their coming."

Electro-Metallurgy. ANNOUNCEMENT of the fact that an electric plant of 20,000 h.p. capacity is to be immediately installed at Sault Ste. Marie, to operate the electric furnaces for the manufacture of nickel steel, for use in the Krupp gun and armor works at Essen, Germany, is a striking indication of the important part which electricity is to play in metallurgical operations and in mining development in the future. It is a fortunate circumstance that the practicability of the long distance transmission of electrical energy by water power for the operation of machinery and the extraction of valuable ores, should have been demonstrated simultaneously with the discovery of many valuable mining deposits in North Ontario and British Columbia. In the latter province a large amount of electric machinery has recently gone into use in mining operations, for rock crushing, hoists, tramways, etc., and is largely assisting to make possible the rapid development of the national resources.

Wiring Rules. IN the discussion which took place at the recent convention of the Canadian Electrical Association, the fact was established that managers of electric companies are being subjected to much unnecessary annoyance and expense for lack of a uniform system of rules authorized by the Underwriters Association which should govern methods of electric wiring in all parts of Canada. It was likewise pointed out that in connection with such a uniform system there should exist one central authority to whom all questions in dispute between the companies and the inspectors might be referred, and whose interpretation of the regulations and decisions on disputed points should be accepted as final. At present the regulations differ as between one province and another, and even as between the inspection divisions of a single province, while each inspector interprets for himself the meaning of the particular set of rules under which he works. A wireman who has learned his business in Ontario, on removing to Quebec, finds himself confronted by regulations and methods differing so widely from those to which he has been accustomed that he is almost obliged to learn the business over again in case he is fortunate enough to be able to secure employment. The electrical companies claim that owing to unnecessary restrictions imposed by the underwriters the development of the industry has been retarded. To what extent this is the case we are not prepared to say. No one having the welfare of the industry at heart would wish to see relaxed any regulation necessary to the performance of work in a scientific, safe and substantial manner, but care should be taken to avoid imposts which, while not essential to this object, give rise to uncertainty, dispute, annoyance and expense. We have no doubt that as the result of the conferences which are to be held between the committee of the association appointed for the purpose and the underwriters, many at least of the causes of objection urged against the present wiring regulations will at an early date be removed. The Canadian Electrical Association is demonstrating its usefulness by dealing with this and other questions of like importance affecting the electrical interests, and is thereby commending itself to the sympathy and support of the electrical companies. Such questions may be expected to continually arise, and they can only be satisfactorily dealt with by an organization representing the interests involved.

Hazards of Acetylene Gas. FIRE underwriters are still watching with no little concern the results following the use of acetylene gas as an illuminant, and from their observations and research are adopting rules to govern its use. Wherever the subject has been given attention, it has been found necessary to place stringent restrictions upon the employment of this gas. The National Board of Fire Underwriters of the United States have approved of a set of rules, based upon a special investigation of acetylene gas made by Prof. Henry Morton, of the Stevens Institute of Technology. These rules provide that the generating apparatus be situated in an outside fireproof building, that no artificial light be used in such building, and that the storage of liquid acetylene in any building, or the use of liquid acetylene gas, be absolutely prohibited. Mr. F. M. Griswold notes, in the Insurance Press, some of the physical characteristics of calcium carbide and acetylene gas as developed from investigations conducted by a number of European and American professors, and which are therefore of much significance. Commenting upon these characteristics, Mr. Griswold says : "The resume clearly demonstrates that grave fire explosive hazards are inherent to both calcium carbide and acetylene gas under conditions liable to supervene in every-day practice, as now permittted by some of the insurance organizations throughout the country, and it is high time that some concert of action be had by the insurance interests to secure the adoption of rules and regulations which, while granting the broadest latitude consistent with safety, will not unduly hamper the vendor, nor prove too onerous for profitable use of the apparatus by the purchasers." To convince some parties of the possibility of attaining high temperatures in the generation of acetylene gas from calcium carbide, Mr. William DeWitt, inspector for the Philadelphia Fire Underwriters' Association, made a test on June 18th last. Fifty pounds of carbide were bought in the open market, and one-half of same placed in a barrel open at one end. At 8 a.m. these twenty-five pounds were soaked with water and the gas allowed to escape ; then the balance of the carbide (twenty-five pounds) was placed on top of the first and pressed down, the intention being to produce conditions which would pobably be met with should carbide on storage or under shipment become wet from the bottom, but the whole quantity not water soaked. Six hours later, at 2 p.m., smoke from burning wood was found to be issuing from between the staves of the barrel, and at 3 p.m. the barrel staves were in flames at the bottom. After smothering the fire, it was discovered that the bottom of the barrel had been entirely consumed.

S. C. Drummond, representing the British Electric Traction Co., of London, Eng., has applied to the town council of Nelson, B.C., for a charter for an electric street railway. The council has signified its willingness to grant the application on suitable terms.

A deputation of Toronto gentlemen approached the town council of Paris, Ont., recently on the subject of the construction of an electric railroad between that town and Ayr. It is understood that a charter has been applied for. A company is also seeking a charter under the name of the Grand River Electric Light and Power Co., to construct a stone dam across the river at Mr. Cavan's farm, with the object of supplying light and power. Mr. Fair, of Brantford, is the company's engineer.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE. Secretaries of Associations are requested to forward matter for publication in this Department not later than the 6th of each month.

TORONTO NO. 1.

Toronto No. 1 have elected new officers as follows: President, Charles Moseley; vice-president, H. E. Terry (acclamation); recording secretary, J. W. Marr (re-elected); financial secretary, A. Stute; treasurer, S. Thompson (re-elected); conductor, W. Clarke; door-keeper, J. C. Long; trustees, J. Fox, J. Huggett and W. Webb; delegates to the annual convention, J. Fox, C. Moseley, W. Webb, A. M. Wickens and T. Eversfield.

MONTREAL NO 1.

The first annual meeting of Montreal No. 1, since their removal to their new hall, 1863 Notre Dame street, was held on the evening of June 20th. The auditor's report for the fiscal year showed that the association was fairly prosperous financially, having a credit balance for the year. The election of officers for the coming year resulted as follows: President, Geo. Hunt; first vice-president, Wm. Ware; second vice-president, J. G. Robertson; treasurer, Thos. Ryan; secretary, Hy. Nuttall; conductor, W. Wadey; doorkeeper, J. Huntingdon; librarian, F. Thompson; corresponding secretary, P. McNaughton.

LONDON NO. 5.

At the last meeting of London No. 5 the election of officers took place. The result was as follows: Duncan McKinley, president; William Blythe, vice-president; G. B. Risler, treasurer; W. Allen, corresponding secretary; W. Meaden, minute secretary; James Harding, conductor; Henry Geldart, guard. The installation of officers was carried out in a very efficient manner by the past president, J. D. Campbell. Some questions were asked and discussed. The heating surface of a tubular boiler, 60 in. in diameter by 12 ft. long, with 84 3-inch tubes, was figured out on the blackboard by the past presidents, which was followed by a general debate on the water consumption per indicated horse power.

MOONLIGHT SCHEDULE FOR SEPTEMBER.

Day of Month	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1	No Light.	No Light.	.....
2	No Light.	No Light.	.....
3	P.M. 7.00	P.M. 9.20	2.20
4	" 7.00	" 9.20	2.20
5	" 7.00	" 9.50	2.50
6	" 7.00	" 10.40	3.40
7	" 7.00	" 11.30	4.30
8	" 7.00	A.M. 1.00	6.00
9	" 6.40	" 1.10	6.30
10	" 6.40	" 2.10	7.30
11	" 6.40	" 3.10	8.30
12	" 6.40	" 4.20	9.40
13	" 6.40	" 4.30	9.50
14	" 6.40	" 4.40	10.00
15	" 6.30	" 4.40	10.10
16	" 6.30	" 4.40	10.10
17	" 6.30	" 4.40	10.10
18	" 6.30	" 4.50	10.20
19	" 6.30	" 4.50	10.20
20	" 7.20	" 4.50	9.30
21	" 8.20	" 4.50	8.30
22	" 9.20	" 4.50	7.30
23	" 10.30	" 4.50	6.20
24	" 11.00	" 4.50	5.50
25	" 11.40	" 4.50	5.10
26	.....	.....	3.50
27	A.M. 1.00	" 4.50	
28	No Light.	No Light.	
29	No Light.	No Light.	....
30	No Light.	No Light.	....
		Total..	171.30

LEGAL.

BELL TELEPHONE COMPANY VS. CITY OF HAMILTON.—The Bell Telephone Company appealed from the decision of a board of three county judges affirming the decision of the Court of Revision for the city of Hamilton, whereby the assessment of the appellants for 1898 was confirmed. The part of the assessment in question upon this appeal was that upon the poles, wires and conduits of the appellants, at $13,490. The appellants complained of the assessment of these articles as real estate, and also contended that it was excessive, the value for assessment being determined by taking the gross cost and deducting 15 per cent. for wear and tear. The Court of Appeal held that the equipment could only be taxed for their abstract value as raw material.

TRENTON ELECTRIC COMPANY VS. TOWN OF TRENTON.—This suit was brought for damages for breach of an agreement between plaintiffs and defendants, for specific performance of the agreement, and for a declaration of rights. The agreement contained no assent in express words to the plaintiffs placing their poles in the streets or stretching their wires across them; but the trial judge held, having regard to the method ordinarily adopted for transmitting the electric current, that it must be taken that defendants impliedly granted to plaintiffs such rights for these purposes as might be reasonably necessary to enable plaintiffs to carry out their engagements and to enjoy the rights conferred upon them, but there was nothing in the agreement to indicate that the purposes which the contracting party had in view were other than local and confined to the limits of the town,' and the defendents could not be taken to have assented to the contract which would enable plaintiffs to use the power, which defendants had acquired at great expense, in order to build up their own town, for the purpose of promoting the interests of a rival municipality, and therefore plaintiffs were not entitled to transmit their power to Belleville. The Court of Appeal agreed with the Chief Justice's view and dismissed the appeal with costs.

HULL ELECTRIC CO. VS. OTTAWA ELECTRIC COMPANY.—The Hull Electric Company instituted an action in the Superior Court to compel the Ottawa Electric Company to remove its electrical apparatus from the city of Hull, and to cease supplying electricity to Hull and the people therein, and claiming $20,000 damages. The Ottawa Electric Company contended that it also had obtained from the city of Hull the privilege of supplying electricity there; that this privilege was granted to the Ottawa company previous to the grant to the Hull company; that the Hull company did not and could not have an exclusive privilege; that if the legislature of Quebec granted such exclusive privilege it was ultra vires of the said legislature. Mr. Justice Lavergne maintained the defendants' contentions. He held that the exclusive privilege claimed by the Hull Electric Company is ultra vires, null and void; that the local legislature exceeded its powers in attempting to give to the Hull company the exclusive privilege claimed by the latter; that electricity is a commercial commodity, the sale and supply of which cannot be given exclusively to any person or corporation; that the federal government alone has the power of granting such privilege or franchise. The action was consequently dismissed with costs.

PATENT RIGHTS.

THE General Engineering Company of Ontario, Limited, manufacturers of the Jones' underfeed stoker, have taken action in the Exchequer Court against the Dominion Cotton Mills Co., of Montreal, for having in use in their establishment a device which is claimed to be an infringement of the plaintiffs' patent rights.

Plaintiffs claim as follows: 1. That the defendants, their agents, servants and workmen may be restrained by injunction during the continuance of each of the said letters patent, from making, constructing, using or vending to others to be used in the Dominion of Canada, any boilers, furnaces or mechanical stokers, made according to or in the manner described in the specification of such respective letters patent or according to or in manner only colourably different from the same, and generally from infringing the rights of the plaintiffs in respect of such letters patent. 2. That the defendants and each of them may be ordered to deliver up to the plaintiffs all such boilers, furnaces and mechanical stokers as aforesaid, as are in possession or power of the defendants. 3. That the defendants may be ordered to pay damages to the plaintiffs for the infringement of their said patent rights. 4. That the defendants may be ordered to pay the costs of this action. 5. That the plaintiffs may have such further or other relief as the nature of the case may require.

Mr. Terence Canetty has been appointed engineer at Osgoode Hall, Toronto.

A company is being formed at Brantford, Ont., to construct an electric road between Waterford and Port Dover.

The village of Campbellford, Ont., has voted in favor of raising $8,000, for the purchase of an incandescent lighting plant, to replace the one now in use.

DAY LOAD FOR CENTRAL STATIONS.

By "Economy."

How to obtain the greatest possible return for a given capital expenditure is a problem that interests investors in all lines of business, and not exclusively electric stations. It is one, however, that possesses a special interest for electrical investors, because, if their business be confined solely to lighting, then their whole investment is earning money during only a portion of each twenty-four hours, is not running for any considerable time at anything like full efficiency, and has yet to pay interest, depreciation and all other fixed charges, all day and every day. If the prices obtainable for electric light were not so very much affected by competition from gas, the matter of obtaining some extension of business for the plant would not assume such great importance; as it is, however, every means of increasing income without proportionately increasing expenditure should be thoroughly investigated. An electrical power house has four possible sources of income—light, power, heat and current for electrolytic purposes—and whether these are possible practically or only theoretically depends solely on local conditions. Before considering the several possible features of a day load, it may be as well to consider why such a load is deemed to be advantageous what is the benefit (pecuniary, of course) to be derived from it?

In every central station there are certain fixed expenses, such as depreciation, taxes, insurance, interest on bonds, etc., that have to be provided for by the operation of the plant; and in a purely lighting plant, operating only about twelve hours on the average per day, the proportion of such fixed expenses borne by each 24 hours has to be provided by each 12 hours' run; or, one hour's run has to earn two hours' fixed expenses. If, now, work could be obtained for the plant during 16 hours, then the strain would be reduced, for one hour's operation would only have to earn 1½ hours' expenses, and so on. Another way of looking at the same question is that, assuming a certain more or less definite aggregate station output for each 24 hours' run, this aggregate amount can be generated in 18 hours' running by a smaller amount of machinery (and therefore at a lower charge for fixed expenses) than would be required for generating it in a 12 hours' run. Or, putting the matter broadly, the "time-efficiency" of a plant is greater the longer it runs per day.

The matter is, however, greatly complicated for the larger number of the central stations in the Dominion, by several very practical considerations; and it becomes a point for very careful investigation as to whether in any particular case a day-load is an advantage or very much the reverse. In the present state of the electrical manufacturing industry, it is open to doubt as to whether there is a really satisfactory and efficient single phase alternating current motor; and as the conditions in which direct current for distribution is equally as good an investment as alternating current are somewhat rare in our smaller towns, the day load of motors to be worked up must be sufficiently great to counterbalance the pecuniary loss sustained by distributing with direct current at a higher first cost. And, moreover, where a plant supplies both a power and a lighting load, it is evident that during the winter months the lighting, commencing at about 4 p.m., will overlap the power, which does not stop till 6 p.m. In this case either the two forms of load must come off the same mains, feeders, generators and engines, in order that the size of plant may be kept down, or else the two plants must be kept separate and distinct down to the boilers, at an increased cost for apparatus. In the former case any momentary fluctuation of the power load, acting through the distributing and generating system, will inevitably have an effect on the quality and steadiness of the lighting, which will vary according as the lighting or the power load is greater. In the latter, the duplication of all the necessary apparatus leaves the power question to be solved on the same basis as the lighting question, i.e., "Is there enough business to be done to make it a paying investment?" It may be taken for granted that no extensive, or even moderately large power business can be satisfactorily done by single phase motors. These can at best be regarded merely as an expedient—bad at the best—so the matter remains between d. c. distribution and polyphase, and comes down ultimately to the above result.

In summer time, no doubt, the power load will come off before the lighting commences, so that the same machinery will perform double duty, the only extra expense being for day wages and for fuel. But just as soon as the afternoons get short, and lighting starts up earlier and earlier, then the services will overlap, and there will have to be enough generating machinery for both combined. Looking at it in this way, there doesn't seem to be much advantage in working up a small day load, which will require extra machinery and day wages, and in probably the majority of cases it would not pay at all. But the operating industry has now arrived at a stage where it becomes advisable to investigate all these questions, and accept the results arrived at, even if they involve remodelling entire systems at considerable expense.

In most towns there will be found a waterworks system using direct pressure by means of pumps with or without storage tank. This will often afford a nucleus of a day load which may be profitably added to. Insurance requirements generally are that a certain hydraulic pressure shall be kept over the whole piping system night and day, which, of course, requires two shifts of engineering staff. An electric company having already a night shift provided, would only require a day shift to do this service, and could probably make arrangements with the town authorities for running the waterworks, which would save the town so much in wages alone as to make it good business for them to contract with the company, and yet have a good margin of profit for the company.

Arrangements could probably be made so that the electric plant could be placed in a building adjacent to the pump-house, and the two services combined under the one staff. The pumps could either be operated by steam as usual, or else (and preferably) electric pumps could be used. In this latter case it is probable that a considerable fuel economy could be effected, as the combined efficiency of an expansion engine, a high class generator and motor, would exceed that of a steam pump, which is not recognized as a very efficient steam-using apparatus. Thus the town would save the expense of an entire engineering staff and fuel, while the company would have a paying nucleus for a day load. Even though the two plants could not be combined in the same building, the pumps could be operated electrically, and a sufficient price obtained for the service to pay all expenses and leave a little over. Waterworks that use a standpipe generally arrange to do a certain number of hours pumping during the 24 hours, leaving the pipe to supply the demand during the rest of the time. This presents a particularly favorable case for the electric company, for then it is always possible to do the pumping during daylight hours, between 9 a.m. and 4 p.m., except in the "lawn" season, when it will begin at say 6 a.m. and go on to 6 p.m. But then at this season lights are not required till later in the evening. So that this case allows of the station plant being run during a longer time every day, doing pumping and lighting with the same boiler and engines, and perhaps even the same generators, if they are either d.c. or polyphase alternating.

The mere pumping business may or may not be worth while undertaking, depending on the price, but if there is any other power business to be done in the town at all, it at least provides the machinery and engineer, and the rest can be undertaken on a thoroughly satisfactory basis. Even in this favorable case, however, it will be inadvisable to run motors off the regular lighting circuits, for two if not more reasons. First, unless the lighting be done solely on the meter basis, there will always be a certain number of persons who will allow their lamps to burn all day, simply because they "don't pay anything extra for it," which means unnecessary fuel consumption; and second, because in winter time, the loads overlapping, any fluctuation in the motor load from moment to moment will have an effect on the lights, causing them to flicker. If the proportion of the total motor load to the lighting load be large, and there be any units of considerable size in the former, then the throwing on or off of these large units may considerably affect the lights, but if the proportion be small and contain no large units, then such effect will probably be small, if not negligible. It therefore depends entirely on the proportion between the two classes of load as to whether they may reasonably be run off the same mains and feeders, or whether it will be more advisable to supply them separately.

Another form of day load which can only be availed of in d. c. plants is the storage battery. The main advantage attained in this case is not so much the working up of a day motor load to increase earnings, as the working during a longer period, of a smaller amount of machinery at lower first cost, and higher working economy. It is a matter of common knowledge that the maximum demand on a lighting plant—the "peak"—is very greatly in excess of the average load, and only for a very short time, and that similarly the minimum demand is considerably lower than the average, but lasts for some time. The plant has to have the capacity of the highest demand, and will therefore be operating at full economy for only a very short time during each 24 hours; and as the lowest demand is probably not much over one-quarter of the greatest, and continues for several hours in the early morning, the result is not only that a large amount of capital is lying idle for probably 20 hours out of each 24, but that such capital as is being rendered productive is employed at a very low economy. Storage batteries, while being available for supplying motor load, serve another purpose altogether, and a very useful one. The "peak" of the load may be taken by a battery, which can be charged by the generating plant during the long hours of light load. So the generating plant may be designed considerably smaller than the maximum demand, and can be run for a longer time at nearly full efficiency continuously.

In a d.c. plant, where the waterworks are operated in connection with the electric station as above, careful design in many cases may allow of such a proportion of generating and battery plant as that the former may require to run 20 hours each day at not less than three-quarter load. It will be evident that a very great economy will result, both in first cost and in operation, from such a design.

There is some little future before another method of supplying a day load with no increase of plant, but industrial conditions will have to be considerably modified before it becomes very general. If motor load and lighting load were consecutive always, and never concurrent, as they are during winter months, then it is evident that no overlapping would occur, and one set of generating machinery would be sufficient for both, and could run almost continuously; but while such overlapping is possible, it is necessary to provide generating plant for the sum of the two loads, although this sum occurs only for a couple of hours each day, during three or four winter months. If, during winter, the motor load could be supplied only during daylight hours—from say 9 a.m. to 4 p.m.—then the two loads would not interfere, and no increase of capital would be necessary. In many medium-sized plants, specially favorable terms are offered to manufacturers who will agree to do all their power work between these hours, and other business is refused. In such a case it would probably pay to run a special feeder and main circuit for power supply only, using the same electrical and steam plant to furnish current for power during day as runs the lights afterwards.

It is certainly not every case that presents a favorable field for day load, but the chances are that it would be possible and remunerative more often than is generally considered, and the above suggestions may be of use to some as indicating the direction in which to canvass.

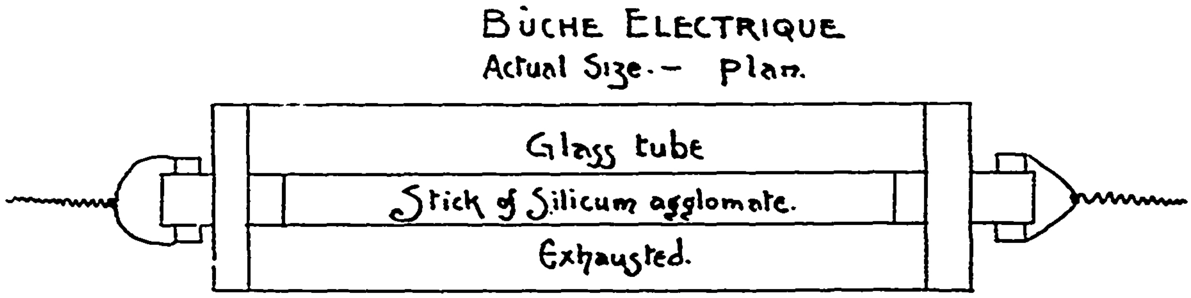
ELECTRIC HEATING AND ITS APPLICATIONS.*

By M. Fernand Le Roy, C.E.

In pursuing his researches Mon. Le Roy sought to attain the following results:

The construction of apparatus of such simple and handy form that the ordinary domestic would experience no difficulty in using it; to make the application readily available in conjunction with the present forms of saucepans, kettles, stoves, irons, etc., so that any change of method on the part of housekeepers would be avoided.

The system is described as consisting essentially in what is called la Buche electrique, or the electric log. A stick of silicum agglomerate metallised at each extremity in order to prevent the overheating of the joints and to insure good contact at the sockets



is inserted in a glass tube, from which, to prevent the oxidation of the silicum, the air is exhausted. The two extremities of the glass tube are set in plaster and the metal ends of the stick are attached to the contact pieces in the same manner as in the case of incandescent lamps (see diagram).

Metal spring clips render the insertion of the heater in the circuit an extremely simple operation.

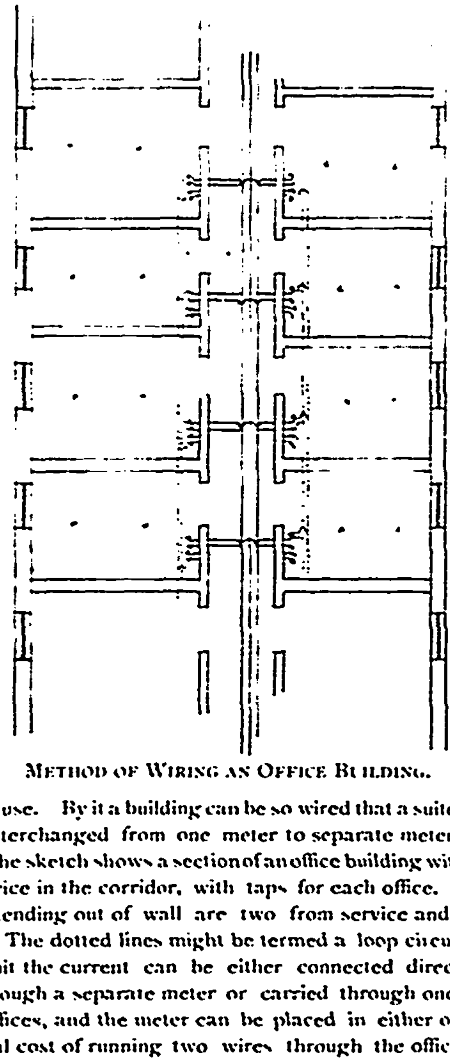
Each buche or heater is constructed of such dimensions and resistance that the power absorbed under a pressure of 50 volts is from 60 to 100 watts, but of course they can be used under any voltage by arranging them in multiple series.

For warming rooms the apparatus would be particularly serviceable, and for general purposes in the kitchen this simple appliance is equally adaptable, as it can be utilized in connection with our present utensils. Hitherto electric cooking devices have been constructed on a much more elaborate and consequently expensive principle, but the method here described bids fair to revolutionize this branch of electrical industry.

* Summary of paper communicated to the Society of Civil Engineers, Paris, Feb. 4, 1898.

WIRING OFFICE BUILDINGS.

Much difficulty is encountered in wiring office buildings on account of the necessity of having to alter offices, and the consequent changes to the wiring for electric light meters. The accompanying sketch illustrates to a certain extent a method adopted by Mr. H. F. Strickland, and which has been put into



Method of Wiring an Office Building.

practical use. By it a building can be so wired that a suite of offices can be interchanged from one meter to separate meters, or vice versa. The sketch shows a section of an office building with a three-wire service in the corridor, with taps for each office. The four wires extending out of wall are two from service and two from outlets. The dotted lines might be termed a loop circuit, and by this circuit the current can be either connected direct to each office through a separate meter or carried through one meter to all the offices, and the meter can be placed in either office. An additional cost of running two wires through the offices, with a tap coming out beside each meter outlet, will save considerable expense in the future. Mr. Strickland, the electrical contractor, 77 Adelaide street east, Toronto, who is the originator of this method, will be pleased to explain the idea to architects and others who may desire to obtain further information.

A very good rule for the power that a belt will transmit is as follows: Multiply the number of square inches in contact with the smallest pulley by the speed in feet per minute and divide by 36,000. The result will be the horse power that may be transmitted, by a double belt, under the most favorable conditions. Deductions must be made according to the judgment of the engineer, for with a single belt under poor conditions but one-half of the above will be realized in practice.

ELECTRICAL POWER TRANSMISSIONS.*

By R. A. Ross, E.E., M.Can.Soc.C.E.

(Continued from June issue.)

The table below illustrates the ratio of plant installed to the output column, one giving the average output per hour figured from the curves for a year, and column two the plant installed to meet maximum demands, while the third shows the ratio between the n

	Incandescent.	Arc.	Motor Power	Street Ry.	Total.
Average E.H.P. per hour.....	604	650	218	2,430	3,902
Max. E.H.P. required	2,925	1,300	656	6,450	11,331
Ratio output to capacity	20.6%	50%	33.3	37.7%	34.4%

It will be seen that the output is only about one-third of that possible with the plant which must be installed. To dispose of

the remaining two-thirds is the ambition of every station manager.

It is just here that the storage battery finds its best field in steam station, but in water power plants it has no place unless the plant be loaded to its full capacity, and an increase is desired which the water available will not admit of.

As an illustration of what is to be expected, the above case is useful, but so simple a case seldom occurs in practice, as instead of having the curves of actual demand, the engineer usually has to draw upon his educated imagination for these, guided by his experience with similar plants.

Having determined the amount of power required for the various demands, and fixed upon the best method of distribution to meet those demands, the problem of the transmission may be taken up intelligently point by point.

GENERAL SYSTEM.

Considering the direct current as out of the question for large transmission purposes, three different alternating systems present themselves, namely, single, two and three phase. The first we are thoroughly familiar with, owing to its use in the purely lighting stations, where it is entirely satisfactory, but when it is necessary to distribute power for motor purposes, it fails, owing to the fact chiefly that single phase motors, while practicable, are not found suitable in operation, as they are not readily started from rest.

The question therefore hinges upon the point of relative superiority of the two and three phase systems.

So far as apparatus is concerned, these two systems are about on a par for all practical purposes when designed for the same conditions of operation, but for the line the three phase has the best of the argument, the transmission copper being reduced 25 p.c. This point of superiority, however, loses much of its effect, for it is possible to use two phase apparatus at both ends of the line, and by means of suitable transformers change from two to three phase for the transmission, in which case the capacity of the transformers used must be slightly increased, as some of the copper is partially inactive when coupled up for change of phase.

For this reason the three phase will be adopted in the case under consideration, as being probably the cheaper in first cost and equal in efficiency.

VOLTAGE OF TRANSMISSION.

As the copper in the circuit varies inversely as the square of the voltage for the same loss and distance, the advantage of high voltage becomes apparent. Conversely with the same distance and copper, the loss in line may be reduced in proportion to the square of the proportionate increase, or the distance may be increased directly as the increase, and any combination of these may be attained by simply raising the voltage.

On the other hand, the apparatus installed must be designed to resist the effects of the increase on the insulation, and greater precautions are necessary to maintain it in operative condition. The cost will also be somewhat greater where especially high voltages are used.

The highest voltage in practical operation at the present time, so far as I am aware, is at Ogden, Utah, where 16,000 is used with raising transformers.

The highest generated directly on a machine without the aid of *transformers is 12,000, at the Chambly plant. There are several* now building, however, which contemplate a line voltage of 20,000, and we may expect to see this figure increased from time to time as methods of insulation improve.

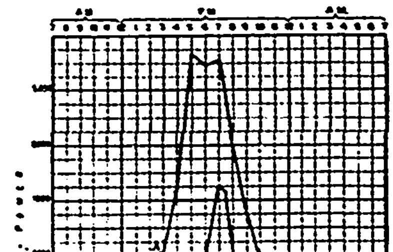
It is well to remember that the apparatus will be called upon to resist much more than the normal pressure, owing to conditions of load to opening of circuits under load, and to lightning, so that a large factor of safety is essential where high voltage is desired.

PERIODICITY.

In former years a high periodicity of 120 to 133 per second was general, being suitable for lighting purposes, and by reason of the high period, transformer costs were low. With the advent of the alternating motor and of long transmission lines, the periodicity dropped to 60, which is now the standard in America. In Europe, however, the tendency is to go even lower, and each maker of apparatus appears to have his own standard.

The lowest possible where incandescent lighting is to be done is 25, for at this alternation the fluctuations are just visible in the light.

The effects of lowering the periodicity are to decrease induction



effects (which are always objectionable), simplify and cheapen the motor equipment and to increase somewhat the cost of transformers.

It would appear that for general transmission work, which involves the use of much power for motors, a lower alternation would have met the case speeds better, but as 60 periods has been universally adopted on this continent, it will probably be maintained for some time.

REGULATION.

Owing to the copper losses and induction effects at various loads on the system from the generator shaft to the lamps or motors, the generator voltage must be raised as the load increases. It is very desirable that this increase be kept as low as possible, so that a continual adjustment of the voltage be not necessary, rendering the lights unsteady.

To this end the copper losses, and especially the induction

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* Paper read before the Canadian Society of Civil Engineers, March 10th, 1898.

effects, must be kept within bounds. The first involves only the cost of the copper, the latter depends upon the nature of the demands and the relative positions of the copper conductors. The induction of lines and apparatus has an effect somewhat similar to that of the inertia of water in long pipes, and causes the current to lag behind the voltage, necessitating a large output of volt-amperes to produce watts, and, as lines and apparatus must be of sufficient capacity to carry the useless increase of current and the generator to allow for the useless additional volts, an increased capacity of plant is necessary.

These induction effects may have a larger influence on the regulation than the necessary copper losses, and should be carefully watched.

It is well to bear in mind, however, that the increased volt-ampere readings do not represent additional power consumption, as would be the case in direct current, as they have to be multiplied by the cosine of the angle of lag (which is always less than unity) to give the true power.

Poor regulation therefore cuts down the capacity of the plant, and renders it difficult to maintain the voltage constant under varying loads.

Having thus sketched the main points which affect the general working of the plants, the apparatus may be taken up in detail.

DISTRIBUTING STATION.

The reducing transformers necessary for lowering the line voltage to that suitable for the incandescent distribution, arc light motors, and rotary transformers for railway service, must be of the highest grade to stand the high line potential, as well as the increases of voltage to which they may be subjected under certain conditions. Of course the efficiency should be of the highest and the regulation good. As the heat developed is great, an air blast or circulation of cool oil is provided.

The rotary transformers which form such a large part of the load in this case partake both of the nature of alternating motors and of direct current generators. As an alternating current motor of synchronous type they must be self-starting, and in consequence are of either two or three phase.

As a generator they must, at the speed established by the synchronous motor part, give the necessary direct current at the proper voltage for the trolley line, as both the motor action and the voltage generation take place in the one set of armature windings, and as the fields are common to both there is a certain ratio of impressed alternating voltage to direct voltage at the commutator, which is constant, and any change of field strength alters the direct current voltage only indirectly by causing a leading or lagging current in the transmission lines, thus giving more or less volts to the alternating side of the machine.

Owing to this effect of over or under excitation of the rotary upon the line currents, causing them to lead or lag behind the voltage, this apparatus may be arranged to keep the current and voltage of the line in phase, thus doing away with the troubles from lagging currents which so unfavorably affect the system in the matter of regulation. On the other hand, where there is no necessity for close regulation, the line induction is encouraged, and is found useful in overcompounding the direct current side of the rotary automatically, thus giving the rise of voltage with load, so desirable in railway work.

In the present case, if the lighting and railway loads be carried upon separate lines, the latter arrangement is desirable, as the lighting will have good regulation while the railway service will overcompound automatically.

The total load for railway needs being 6,450 E.H.P., and the average from 7 a.m. to 9 p.m. being 3,000 E. H. P., seven units of 1,000 E.H.P. should cover the demands, and the machines in operation should have a good load factor.

For the arc light demands as before stated, eight units would be sufficient. The motors may be either synchronous or induction, the former preferably, as they may be useful in assisting the regulation of the incandescent lighting service by proper excitation, as their loads do not fluctuate.

This apparatus, with the necessary switchboard and instruments for the high potential receiving and lower potential distributing circuits, completes the distributing station equipment.

TRANSMISSION LINE.

The line is usually the weakest link in the chain, being exposed to the weather, and not under that careful supervision which is given to the rest of the plant.

The pole line as a supporting structure must of course be of the solidest to stand the strains imposed, not only by the weight of copper, but in these latitudes by a great weight of ice also, which, if assisted by a gale, will try the best work to the utmost.

Poles of cedar, pine or chestnut of very heavy section are necessary for this work. They should be set in concrete or broken stone and heavily guyed on curves, or in certain positions double poles with heavy cross-arms between should be used.

The insulators for high potential work are universally made of porcelain, as that material weathers better than glass and is not so hygroscopic.

This porcelain should be so thoroughly vitrified as to exhibit a fracture like glass when broken, otherwise it will absorb moisture and break down.

To minimize surface leakage, which, if severe, may burn off the pins, the surface over which it has to take place is made as long and of as small surface as possible. To assist in reducing this leakage, insulators with oil in grooves, over the surface of which the leakage must take place, have been tried and found to work well when the oil surface is clean, but in operation dirt accumulates and troubles ensue, so that the plain porcelain insulator of large insulating surface and high resistance to piercing is now the standard.

The copper circuits are of bare copper, as weather-proof insulation at high voltages is perfectly useless, the cross-section of the copper being of course so proportioned as to give the loss determined upon as suitable for the conditions existing. These conditions depend upon the cost of the power, the amount available and the demands. The loss may be reduced to any extent by the use of more copper, but unless there is a demand for the power saved, which will pay interest and depreciation on the additional cost of circuits, no economy results.

On the other hand, the copper may be reduced and the losses increased, but only within the bounds set by the demands of good regulation.

In practice a loss of 15 per cent. is seldom exceeded, and a very common allowance is from 7 per cent. to 10 per cent.

Several effects manifest themselves in alternating lines which do not exist on those of direct current systems, and they deserve the clo est attention in planning the system. While the actual losses in direct and alternating work are about the same under the same conditions, the drop in voltage in the former is a measure of that loss, while in the latter it may be no indication.

In fact, it is possible to so arrange the circuits in some cases of alternating work as to have a greater voltage at the end of the circuit than is generated at the station, but this does not indicate that the line generates power of itself; it simply means that, while the self-induction and capacity of the line and load raises the voltage, much as a water ram in a pipe line raises the pressure, it at the same time throws the current out of phase with that voltage, and the real power is that obtained by the multiplication of the apparent volt-amperes by the cosine of the angle of lag introduced. It is therefore only possible to read the power indications on a watt-meter, which instrument takes account of this angle, while the volt and ampere meter readings which are used to determine direct current power are not reliable for the alternating.

This increase of voltage may under certain conditions become so serious as to endanger the insulation of line and apparatus.

In most cases it is advisable to reduce the induction as much as possible, and to effect this the wires on opposite sides of the circuit are strung as closely together as is consistent with safety, and several wires of equivalent cross section used rather than a smaller number of larger area.

To do away with unbalancing of the phases of the system, the circuits should be strung symmetrically, which is affected in the case of two phase lines by placing the going and returning wires of each phase on the opposite ends of the diagonal of a square, and in three-phase lines by stringing the three conductors at the corners of an equilateral triangle.

As lightning may cause trouble, not only by direct stroke, but by the accumulation of static electricity upon the lines, means must be provided for getting rid of it safely. To this end, guard lines of barbed wire are strung above the circuits, and these are grounded at frequent intervals.

GENERATING PLANT.

The apparatus in this part of the plant consists of the water-wheels, generator, raising transformers and switchboard apparatus.

Regarding the latter two, the same remarks apply as were made regarding similar apparatus in the distributing station.

As to the generators, their size is usually limited by the powe of the water-wheel units, and their speed by the wheel speed, unless gearing be used.

The usual method of attacking the question with direct-connected units is to arrange for as powerful wheels as is possible consistent with having the proper size units to handle the load properly, and designing the generators to suit the wheels as regards size and speed.

Vertical turbines with the rotating part of the generator revolving in a horizontal plane are usual, but, in several recent plants, horizontal turbines are used direct connected to the generators, which in that case are below the crest of the dam and above the tail-race by an amount determined by the height of the draft tube. The first system introduces footstep bearings, which are always more or less objectionable, but removes the delicate armature windings from chance of damage by water. The second places the generator at the mercy of water-tight bulkheads and stuffing-boxes.

As to the voltage to be generated upon the machines, if raising transformers are used, this is of little consequence unless from a machine designer's point of view, as the transformers will have equal efficiency at any ratio of transformation.

Where the transmission voltage is not dangerously high, it is of course preferable to do away with these transformers, and generate directly on the machine.

In deciding this point it must be kept in mind that the failure of a transformer through the breaking down of insulation is a much less serious matter than that of a generator, which is less likely to occur when that apparatus is of low voltage. Owing, however, to improved types of generators, we may expect to see raising transformers dispensed with in many cases where they would have been deemed indispensable with older types.

In specifications drawn up for the generating apparatus, the following points are strongly insisted upon:

(1) That the heating of any part shall not exceed a certain specified temperature after a certain length of run at full load and an additional time at a certain specified overload.

(2) That the efficiency at full load, three quarters, one half, and one quarter loads, shall be guaranteed by the tenderer and proved by test.

(3) That the regulation of the generator shall be within a certain per cent. at full non-inductive load.

(4) That the insulation of any part of the machine shall not break down under a specified voltage which is high enough to allow of a good factor of safety over the normal pressure.

Although it is impossible to specify limits for these requirements which will suit every case, it may be said generally that the allowable increase of temperatures for large generators ranges from thirty to forty degrees centrigrade. The full load efficiency from ninety-four to ninety-six per cent. The regulation depends upon whether the machine is compound wound or not. In the former case the regulation may be anything for which the compounding is set, and in the latter from three to ten per cent.

The test voltage applied ranges from three to ten times the operative, the former factor for high voltage machines, the latter for low voltages.

The modern generator being either of the inductor or revolving field type, in which the high potential armature windings are stationary, lends itself to high voltage generation, as the insulation spaces may be increased largely without rendering the machines unwieldy, for the reason that the armature wires are distributed over the outside ring where space is more abundant, and the vibration of running, which abrades, and finally breaks down the insulation on the older revolving armature types, is largely absent in the newer machines.

Having sketched in a general way the points to be considered, and determined upon the general features of the transmission, we may take up the figuring of lines, efficiencies and horse-powers to be generated.

To do this, certain assumptions must be made as to the allowable efficiencies of the line and apparatus at various loads, which has been done in the tables below. As regards the apparatus, commercial efficiencies have been assumed which are usual for this class of work, and will be guaranteed by the manufacturers. The line efficiencies are what would be usually allowed, considering the copper as designed for those efficiencies at maximum demand.

	Loads.			
TRANSMISSION (generator to sub-station)	100%	75%	50%	25%
Generators	96	95	94	90
Line	90	92.5	95	97.7
Raising and lowering transformers	96	95	94	90
Total efficiency of transmission	83	83	84	79

	Loads.			
INCANDESCENT (distribution to lamps).				
Primary distribution at 2,000 volts	96	97	98	99
Large reducing transformers	97	97.5	97	95
Secondary distribution to lamps	97	98	98.5	99
Total efficiency of distribution	91	92.5	93.5	93
ARC LIGHTING (distribution to lamps).				
Efficiency of motor	92			
Efficiency of arc machine	86			
Efficiency of line distribution to lamps	93			
Total efficiency of distribution	72.6			
POWER CIRCUIT (distribution to motors).				
Efficiency of lines	90	92.5	95	97.5
Efficiency of transformers	96	95	94	92
Total efficiency of distribution	86.4	88	87	89.7
RAILWAY POWER (distribution to motors).				
Efficiency of rotary transformers	96	96	95	90
Efficiency of distributing lines to motors	80	85	90	95
Total efficiency of distribution	76.8	81.6	85.5	85.5

From these efficiencies of line and apparatus the whole power necessary for all the maximum demands may be transmitted at an efficiency of 80 p. c. from the generator shaft to the distributing lines in the city.

The total efficiency at full load from the generator shaft to the lamps, railway and stationary motors, is 68 p. c., and under the average running conditions would be not less than 70 p. c.

These figures illustrate the remarkable efficiency of electrical transmission even on such a mixed and varying load. It will be noticed that at varying loads the efficiencies are not very different, owing to the fact that, while the apparatus falls off, the line increases in efficiency, thus maintaining a balance.

In fact, under light loads the efficiency is higher than under heavy, and is actually higher than given in the totals, because the tables consider the whole plant as operating at fractional load, while in actual running the apparatus would be kept at full load by shutting down units as the load dropped, thus raising the efficiency. The figure of 68 p. c. therefore may be safely taken as the lowest to be met with during the course of the year, and as it holds only for the peak of the load will not affect the average efficiency materially.

The date assumed or calculated for the transmission is given below.

The power is that necessary at the distributing lines to take care of the maximum demands as shown on the curve of total power. The power factor is assumed to be 100 p. c. for the class of load considered, loss in transformers 4 p. c., in line 10 p. c., which is not too high for the peak of the load, as this is what the line is designed for.

Electrical H. P. required at end of transmission line	11,946
Voltage of transmission at end of transmission line	15,000
Periodicity or complete cycles per second	60
Distance transmitted in miles	10
Power factor assumed p. c.	100
Loss in transformers p. c	4
Loss in line p. c	10
System of transmission—three phase	

Figuring the transmission on the above assumptions the actual electrical horse power at the generator terminals is 13,623, while the apparent horse power as read by volts and amperes is 13,862. In other words, while the real loss in the transmission is 14 p. c. of the power required at the end of the line, the apparent loss is 16 p. c. This shows a high power factor for the whole system, and is obtained by a non-inductive load on a line well subdivided, and with the wires properly placed.

To illustrate the effect of an inductive load upon the amount of apparatus necessary, another line with a load power factor of 90 p. c. has been figured, the other conditions remaining the same as before. This, while having the same losses as in the first case, requires 17,327 apparent horse power at the generator, necessitating an increase of generating apparatus of 25 p. c., or, in case the plant were installed, it would cut down its capacity 20 p. c., and would decrease that of the distributing apparatus 10 p. c.

Were it not for these induction effects the problem would be as simple as in the case of direct current work, but as it is, they affect the matter to a very great degree, and require the most careful consideration to arrive at even a fair approximation to actual results.

Considering the fact that this power is laid down from the wheels with such simple machinery with but at most one revolving part, and therefore requiring no attention when once started, it is not surprising that electricity should have monopolized the field. The efforts at the present time to transmit to longer distances will be successful in proportion as the knowledge of insulating methods increase; and, from the rapidity with which the present voltages have been attained from the lower formerly prevailing, it is not difficult to forsee the time when this country, which is so rich in water power, will be literally covered with power lines for all purposes The possibilities in the way of covering an increased territory by raising the voltage may be illustrated by the plant considered above, where, with 15,000 volts and 14 p.c. loss, the power covers a radius of ten miles in all directions. If the voltage were doubled, and the same loss allowed, the radius would be 40 miles, and the territory covered would be sixteen times as great. In other words, the area served will vary as the fourth power of the ratio of increase of voltage. The question of the advisability of transmitting from a distance the natural power available in preference to generation at the centre of distribution by steam power, requires the most careful attention. The cost of the power laid down on the consumer's premises is made up of two items, namely, fixed charges and operating expenses. The first includes interest and depreciation on the plant, the second coal and supplies, attendance, etc. The saving by the adoption of water power is in coal and supplies, and perhaps a small part of the labor, provided the plant cost is the same. Should, however, the cost of the transmission scheme be enough larger than that of the steam to eat up the saving in interest and depreciation on the increased cost of plant, there is nothing to be said in favor of the transmission.

If there is no cheapening of cost the steam plant has the advantage of the greater reliability in lines and apparatus, as no high voltages need be used, and there is no risk of troubles with water power during the winter such as exist to a greater or less extent in this climate.

In many cases, however, where the water power improvement can be made with small outlay per horse power rendered available, the gain may be large. It is not so large, however, as seems to be the idea of the public, which considers a water power as capable of producing power for nothing, entirely ignoring the capitalization necessary for development.

The transmission and utilization of electric power has got beyond the experimental stage, and is not now surrounded with that mystery which used to obscure the financial facts, and the more it is considered as a commercial article depending upon the laws of supply and demand for its existence, the more will its usefulness become apparent to the consumer and its financial security appeal to the capitalist.

SELECTION, HANDLING AND CARE OF BELTS.

NEARLY every engineer has one or more belts under his care, and from the condition many of them are in it would seem that a word of advice as to their selection and care would not be amiss, writes Charles H. Garlick, in Lumber.

If, when in need of a belt, the engineer would, instead of simply ordering a certain number of feet of a certain width and thickness, try the experiment of personally selecting the same for the work which he wishes to have the belt do, and then use the same care in placing the belt in use that he does in starting any other piece of new work or new machine, much better results would be obtained than is usually the case. There are many, very many, rules and formulæ for ascertaining the width of belt necessary for transmitting a certain amount of power. No two of these rules agree, because there are so many conditions that enter into the problem that no hard and fast rule can be used.

From the writer's experience he prefers to use the following formula, which in ordinary cases will be found nearly correct:

$$W = \frac{H.P. \times 5,500}{\text{Velocity} \times \text{contact in feet.}}$$

This is single thickness. For double thickness belts:

$$W = \frac{H.P. \times 3,600}{\text{Velocity} \times \text{contact in feet.}}$$

Or the width of the belt can be found by multiplying horse power to be transmitted by 3,600, and dividing the product by the number of feet of the belt that will pass over the pulley per minute, multiplied by the number of feet of belt in contact with the driving pulley. A very good "rule of thumb" for single belts is: Belting 1 inch wide having a velocity of 600 feet per minute, will transmit 1 horse-power.

It should be borne in mind, however, that the width of the belt necessary to transmit a certain horse power depends on several conditions, one of which is the tension of the belt. When a belt is too tight there is a constant waste in journal friction, and when too loose a great loss in efficiency from "slip." A belt should be procured that will deliver the power required in a fairly slack condition.

Between a slow speed and a wide belt and high speed and a narrow belt, choose high speed and narrow belt wherever practicable, in designing for the transmission of power. A velocity of belt up to a mile a minute is practicable and advantageous.

In taking lengths for belts, where it is not convenient to measure with a tape-line the length required, this rule will be found of service: Add the diameters of the two pulleys together, divide the result by 2, and multiply the quotient by 3¼; add the product to twice the distance between the centres of shafting, and you have the length required, very nearly.

In buying, be sure that the leather is oak tanned, has a smooth, polished surface and a fine fiber. It is a good idea to have the belt unrolled and examine it to see that laps are thoroughly made and fastened. Note whether the belt is of the same uniform thickness throughout its entire length, also that the belt is pliable and not harsh and brittle. Note if possible whether the hides which make up the belts are of uniform thickness, or whether the thickness of belt is obtained by splitting the hides, and if the latter is the case reject it.

As to whether you purchase single or double belts, it may be said that single belts can be used successfully up to twelve or fourteen inches in width, but where more power is required than a belt of this width will transmit under the conditions that exist in your plant, belts of double thickness should be used. With single belts, care should be taken to have them of ample width, so that there need be no necessity of having them tight. Double belts should be used when a great strain is to be put on the leather, or for slow speed, or when a belt is to be run at one-fourth turn; belts which you are called upon to shift frequently, or which are to run on vertical shafts, should be double.

As to the respective value of rubber or leather belts: Rubber belts do not cost as much as leather, nor do they, under favorable conditions, last as long. They cannot be used in places where the belt rubs, nor where it becomes necessary to shift often; neither can they, as a rule, be run successfully as cross belts. They should not be used where oil is likely to drop on them, nor where they will freeze. They usually last longer than leather belts in damp localities. Rubber belts will adhere to pulleys better than leather. When a rubber belt commences to wear out it is almost impossible to do anything to repair it. Having purchased a new leather belt, it should, if time will permit, be stretched before being placed in work. This can be done in a variety of ways, depending on the width and length of belt and the time at the engineer's disposal. One way is to stretch it over two pulleys placed some distance apart, and attach weights to either end of the belt. During the stretching period a little oil should be applied to the leather.

Belting for electric lighting machinery must have some characteristics all its own. For ordinary machines a positive steady motion is not absolutely necessary, but with an electric plant it is different. It is necessary for the belt to be endless and of a uniform thickness. Even so small a thing as uneven laps will cause a slight but constant jumping or flickering of lamps. With most dynamos as built to-day provision is made for the purpose of taking up any stretch that may occur in a properly-constructed, designed and well-stretched belt. Yet, should it become necessary to shorten one of these belts, it may be done by using clamps Care should be taken and the laps made as long as possible, and sufficient time given the work before removing the clamps.

While endless belts are to be preferred for almost all work, yet in many places the time, care and experience required to join them is such that recourse is had to the

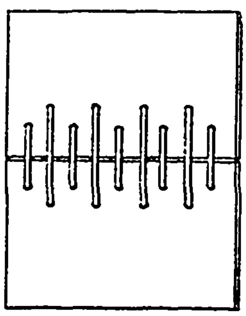


FIG. 1—Side of lacing running next to pulley.

more convenient method of lacing or fastening with clamps or hooks, and of all the different methods the writer has been more successful with and prefers lacing. But even such a simple piece of work as that of joining a belt by means of lace—a narrow strip of rawhide—is sometimes done in a manner to very materially reduce the life of the belt, and very seldom is sufficient time or care given to this work. The ends of the belts should be cut exactly square, using an ordinary tri-square for this purpose. Punch the holes exactly opposite each other in the two ends of the belt to be joined. It is best to use an oval punch for this purpose, the longest diameter of holes being parallel with the belt. Two rows of holes should be made in each end of the belt,

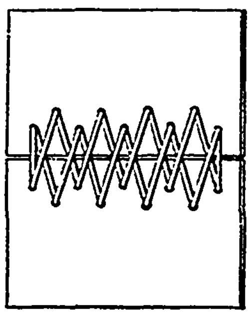


FIG. 2—Outside of lacing.

the same being staggered. The edges of holes should all be at least seven-eighths of an inch from the end or side of belt; be sure and keep the belt square, and lace both ends equally tight. The laces should not be crossed on the side that runs next to the pulley, but on that side laces should run parallel with the belt. Fig. 1 shows the inside of the lacing, or the side that should run next to the pulleys, and Fig. 2 shows the outside of the lacing, the side that is not in contact with the pulley.

In placing the belt on pulley, put it on so that pulley in slipping will run with, and not against, splice or joint. While authorities differ as to which side of the belt should be placed next to the pulley, the writer's experience has been that the best results are obtained when the grain side is placed next to the pulley. Experience has proven that it will drive more than when the flesh side is in contact with the pulley, and that the belt will last longer.

If the belt is to be crossed, do not put it on in such a manner that at the places of passing joints or laps will meet and be turned up and ruined in a short time.

How to place a belt on a pulley is one of the little things one can become an adept in only by practice. If the belt is a heavy one and the pulley runs at a high speed, it is best to slow down the machine, then place the belt on the loose pulley or the pulley at rest. Secure a firm footing, and with the right hand slowly work the belt up to top of pulley, when a quick jerk down or up, according to the direction the pulley is running, will throw the belt on. When the belt is heavy, or the operator lacks experience, it is best to shut off the power, place the belt on pulley as far as possible, then take a small leather belt, or even a rope, double it, slip one end through the arms of the pulley and around the belt and rim of the pulley, and the other end through the loop formed by the double of the small belt or rope; then stand on the floor on the opposite side and draw on the small belt or rope, when the belt will be drawn to the rim of the pulley. When the machine is placed in motion, the belt may be slipped on without any trouble; then, by letting go of the small belt or rope when the belt is on the pulley, the noose will be undone and the small belt will be free.

If the belt does not stay on the pulley, do not erect guards to keep it on, as they are an eyesore, and soon wear the belt out. Besides, the guards simply cure an effect, while the cause remains. The cause may be that the pulley is not in line, or that the belt is not joined squarely, or one side is stretched more than the other. Sometimes a belt running at high speed, transmitting scarcely any power, will wave from one side of the pulley to the other, and if a load is not thrown off will eventually come off. In places where it was not convenient to either put in pulleys of larger diameter, or even wider belts, and where the use of resin, oil and other adhesive matter would not cause the belt to adhere to the pulley, the difficulty has been overcome by running a narrow belt, drawn tightly, with ends laced, over the main belt. In one place where occurred a continual slipping of a ten-inch belt, the writer took an old two-inch belt, placed it upon the ten-inch, and the two belts carried the load for years without trouble.

According to Electrical Engineering, of Chicago, the total number of telephones in use in various countries has been tabulated as follows: Province of Angola, 200; Austria, 20,000; Australia, 2,000; Bavaria, 15,000; Belgium, 11,000; British India, 2,090; Bulgaria, 300; Cape of Good Hope, 600; Cochin, China, 200; Cuba, 2,500; Denmark, 15,000; Finland, 6,000; France, 35,000; Germany, 140,000; Great Britain, 75,000; Holland, 12,000; Hungary, 10,000; Italy, 14,000; Japan, 3,500; Luxemburg, 2,000; Norway, 16,000; Portugal, 2,000; Roumania, 400; Russia, 18,000; Senegal, 400; Spain, 12,000; Sweden, 50,000; Switzerland, 30,000; Tunis, 300; United States, 900,000; Wurtemberg, 7,000. These give a total of 1,402,100.

SPARKS.

H. C. Baird & Son will probably put in an incandescent light plant at Parkhill, Ont.

The Halifax Electric Tramway Company has declared an annual dividend of six per cent.

A movement is on foot at Ottawa to secure a popular vote on the question of operating the street railway on Sundays.

The sum of $20,000 is to be expended for the continuation of the telegraphic service on the north shore of the St. Lawrence.

The C.P.R. are equipping new telegraph offices in Winnipeg, under the superintendence of Mr. W. J. Camp, the company's electrician.

The Royal Electric Co. has installed a 15 h.p. Stanley induction motor for the Montreal Water & Power Co., which is to be used for pumping purposes.

The Common Council of St. John, N. B., has authorized the Safety Board to make arrangements for lighting the city at the expiration of the present contract.

The Royal Electric Co. has secured an order from the corporation of Joliette for a 120 k.w. S.K.C. generator, with full complement of transformers, etc.

The city engineer of Toronto is preparing specifications for an electric plant to be placed in the new municipal buildings, and at an early date tenders for same will be invited.

The Montmorency Power Co., of Quebec, has made an addition to their plant by the installation of another 600 k.w. S.K.C. generator, which was purchased from the Royal Electric Company.

The Napanee Water & Electric Light Co. have gone into the incandescent lighting business, and are now serving lights from their new S.K.C. plant recently installed by the Royal Electric Co.

The Niagara Falls Park and River Railway Company have completed the work of laying their tracks on the new steel arch bridge at Niagara Falls, and the first car was run over it on July 1st.

The Galt and Preston Electric Railway Company have asked the towns of Berlin and Waterloo for a bonus of $40,000, in consideration of connection by their railway with the C.P.R. The by-law to grant $12,000 has been carried by the town of Waterloo.

Messrs. Miller Bros. & Toms, of Montreal, have placed an order with the Royal Electric Company for two 40 h.p. direct current motors. The machines will be direct connected to two Quimby screw pumps, and will be used for the operation of elevators, etc.

A number of Montreal gentlemen have purchased a mountain at St. Bruno, Chambly district, about ten miles from Montreal, and purpose expending a large sum of money in improvements. An electric railway from Montreal to St. Bruno is included in the scheme.

The Sherbrooke Gas & Water Co. has closed a contract with the Royal Electric Co. for two 240 k.w. S.K.C. generators. This is the fifth order that has been placed with the Royal Electric Co. for S.K.C. machinery by the Sherbrooke Water & Gas Co. within the last two years.

It has been decided not to extend the electric railway system of Quebec to Montmorency this year, but everything will be got in readiness during the winter to change the motive power of the entire railway from Quebec to Cap Tourment from steam to electricity next spring.

The recently-formed Ottawa Electrical Association have elected the following officers: Hon. president, T. Ahearn; president, J. Murphy; vice-president, B. Marchand; secretary, E. Bailey; treasurer, B. Nolan. Executive Committee: Messrs. W. G. Bradley, E. J. O'Reilly, P. Grimes and J. Johnson.

On Queen's birthday an electric railway car with sixty tired holiday makers on board was proceeding from Vancouver to New Westminster, B.C., at a rapid pace when an axle broke and the car completely overturned. The 60 occupants were jumbled together in one mass as the car still on its side ploughed along the side of the track. Miraculously as it seems, nobody was killed, though several people were more or less injured.

John Philip, of Grand Valley, Ont., has secured a franchise from the corporation of Arthur for the supply of electric light in that town. He will generate the current at Grand Valley from his S.K.C. plant, and with the aid of step-up transformers transmit it to Arthur, a distance of 16 miles. Mr. Philip will illuminate the streets of Arthur with alternating current arc lamps. The order for the complete work has been placed with the Royal Electric Co.

The adjourned annual meeting of the shareholders of the Hamilton, Chedoke & Ancaster Electric Railway Company was held on June 19th. The reports showed that about $30,000 of stock had been placed. The company wish to dispose of $10,000 more before beginning active operations. Following are the new directors and officers: Messrs. E. A. Clifford, president; Jacob Shaver, vice-president; E. Kenrick, auditor; E. Henderson and W. R. Clarke. Mr. W. F. Walker, Q.C., was re-appointed secretary-treasurer and solicitor.

As sources of energy, it has been proposed to use the peat bogs of North Germany, and what is now practically waste land is expected to become available for manufacturing on a large scale. The bogs of the Valley of the Elms, for example, cover some 13,000 square miles, and the proposition has been made to erect in this section a 10,000 horse power electric plant which would consume annually some 200,000 tons of peat, equivalent to the amount yielded by 200 acres. One acre of bog averaging ten feet in thickness contains abont 1,000 tons of dried peat, and the amount produced on 430 square miles would afford as much heating power as the 80,000,000 or more tons of coal annually mined in Germany. The proposed plan contemplates using the energy on a canal and in the manufacture of calcium carbide.

At the annual meeting of the Ottawa Electric Light Co., held on June 28th, Mr. T. Ahearn was elected president, Hon. E. H. Bronson vice-president, and Mr. J. W. McRae managing director. The revenue for the year was $159,583.54 from ordinary sources of light, heat and power, this amount being an increase over previous year of $5,659.12. The gross expenditure for the year was $109,117.61, an increase of $10,293.58. The report recommended that no dividend be paid for the past half year, but that $12,520 be placed to the credit of rest account, also the whole balance of $24,368.03 to the credit of the profit and loss account. It may be stated that the company paid four per cent. for the first half year and has been paying eight per cent. annually lately, but the directors conclude that proper allowances have not hitherto been made for depreciation and renewals.

Some particulars have come to hand of the project of harnessing the Rio Cobre, in Jamaica, by the West India Electric Company, of which Mr. Henry Holgate, late of Montreal, is manager. The works are situated near the great tunnel at Boy Walk, at which point the river is 160 feet wide. The dam will stretch from one bank to the other, to be embedded in the solid rock. The concrete and masonry sunk in the rock of the river bottom will go ten feet below the water, and above the water the walls of the dam will rise some nine feet or thereabouts. The water is taken in from the dam by a pipe eight feet in diameter. The pipe will convey about 20,000 cubic feet of water, or about 120,000 gallons, a minute to the power works. The pipe will be provided with a steel valve to regulate and control the supply of water to the power house. The pipe which leads from the dam to the power house will run alongside the river for one mile and a quarter. The power house will be built entirely of steel and concrete, the steel work alone weighing 250,000 pounds. The river in its course for one mile and a quarter drops about 47 feet, which, added to the foot of the dam, amounts to 56 feet, which will be the fall of the pipe in its course to the works.

The Montreal Transportation Company have just completed a new elevator at Kingston, Ont., the power house of which is built of brick, 48 x 52 feet. There is a brick chimney, 136 feet high, with a four foot six inch flue. It stands on a thirteen foot six inch square base, running to the height of twenty feet. It then points into an octagon, and from the height of twenty-five feet from the ground the remainder is circular. The engine in the power house is a Corliss tandem compound, with cylinders twenty inch, forty inch and forty-eight inch stroke. There are also an improved Blake twin vertical air pump and condenser, a 600 horse power heater, supplying water to the boiler heated to 210 degrees Fah.; an outside packed boiler, plunger pump, 8 x 5 x 12 feet, for feeding the boilers, and a battery of three boilers, each 16 x 72 inches. There is also a fire pump with a capacity of 750 gallons per minute. The power house is provided with an electric lighting plant. An 8 x 10 inch Ideal engine is direct connected to a dynamo operating at 110 volts, made by the General Electric Company, of Peterboro'. This dynamo lights over 200 sixteen candle power incandescent lamps in the elevator, power house and office, besides twelve special arc lamps on the wharf, being long burning lamps on the incandescent system.

ELECTRIC RAILWAY DEPARTMENT.

THE HULL ELECTRIC RAILWAY.*

By F. C. Armstrong.

At the present stage of electric railway development, there is no subject more attractive to the electrical engineer, or which more seriously demands the consideration of the steam railroad manager, than the possibility, as yet mainly undefined, of the profitable conversion to electrical operation of existing roads operated by steam. In the street railway field, the success of electric traction has been of the "veni vidi vici" order; the mule, the horse and the cable are in process of becoming memories within the short stretch of less than one decade. A similarly successful attack on the larger field at present occupied by the steam locomotive, is another matter. For one thing, the steam locomotive is admittedly doing its work and doing it well and economically; for another, the transmission factor is at present, working it out in any way we choose, a serious limitation of range in the substitution of electricity for steam, even in suburban practice.

The work of the past two or three years, however, has established certain important points, even to the mind of the most prejudiced steam railroad manager. The B. & O. installation at Baltimore has demonstrated the possibility of constructing and operating electric locomotives capable of exerting a greater tractive effort than the most powerful steam locomotives anywhere in use. The work on the New York, New Haven & Hartford branches, on the elevated roads in Chicago and elsewhere, and on the important suburban lines which control the local business centering in Cleveland and other cities, has shown clearly the commercial advantages to be gained by the conversion to electricity where quick and frequent service is demanded over distances up to 25 and 30 miles. There is no doubt that even with our present transmission limitations, a very large field exists for the electrical equipment of suburban and branch lines of steam roads, where the present or possible business is of such a nature that its full development can only be attained under the special conditions of operation rendered possible by the use of electric traction. An excellent example of the successful realization of this possibility is found in the case of the Hull electric railway.

The Hull electric railway runs from Hull, a city of 15,000 inhabitants, lying immediately across the river from Ottawa, the capital of the Dominion of Canada, to Aylmer, a village of 2,500 inhabitants.

Until June, 1897, the main line was known as the Aylmer branch of the Canadian Pacific Railway, connecting at Hull with the C. P. R. and at Aylmer with the Pontiac & Pacific Junction, a road running north some 70 or 80 miles, through the county of Pontiac. While operated as the Aylmer branch of the C. P. R., its business consisted of transferring passengers and freight from the Pontiac & Pacific Junction road to the Canadian Pacific main line, a considerable freight business in hauling lumber from some large mills, located midway at Deschenes, and also what passenger trafic existed between Aylmer and the city of Ottawa.

Hull Electric Railway—Electric Freight and Passenger Train.

Its operation under these conditions was unprofitable, and the Canadian Pacific Railroad was quite willing, when approached by capitalists interested in lumber mills and water power along the line, to lease the property, consisting mainly of 10 miles of single track, for $5,000 per annum. The equipment of the road, for electric traction, was immediately proceeded with, the power house being located at Deschenes, midway between Hull and Aylmer, where an excellent and cheaply developed water power was available. The gentlemen interested in the property are among the most prominent in financial and business circles in Ottawa, and they have not spared any expenditure necessary to put the road in the best possible shape to handle the business and pay a return on the money invested.

The total length of track, including sidings, is 26 miles, the main line running from Hull through Deschenes and Aylmer to Queens Park being double-tracked throughout. It was intended at first to operate the line as a single track road with turnouts, but this was found not to be feasible on account of the number of train units. The right of way was therefore purchased outright from the C. P. R. and a second track was laid down. The rails are of steel, weighing 56 lbs. to the yard; and the ties cedar, of the standard

* Reproduced from the Street Railway Journal, New York.

dimensions, and laid 2,640 to the mile. On the whole line the number of highway crossings at grade is three, one overhead and one grade crossing being made over steam roads. The heaviest gradient on the portion of the line used for freight is 2 per cent.; there is one short grade of 264 feet to the mile, on the branch line running to Queens Park, over which there is no freight service.

POWER HOUSE.

In the power house located at Deschenes there are at present installed six 60 ins. new American vertical turbines, built by Kennedy & Sons, developing at the normal head of 9 ft. 6 ins. 1,000 h.p., the jack shaft speed being 165 r.p.m.

Hull Electric Railway—End Views of Locomotive (Summer and Winter.)

The railway generators consist of two steel frame machines, of the Canadian General Electric Company's standard type, having a capacity of 325 k.w. each. Power is also furnished from the jack shaft to operate two 150 k.w. monocyclic alternators, from which current is furnished for the extensive lighting business of the Deschenes Electric Light Company in Hull and the city of Ottawa. The difficulties usually experienced in speed regulation with water power are largely overcome by the use of an artificial load, thrown on and off the generators by a very simple and positive method designed by the electrical engineer of the company, J. E. Brown, the use of water wheel governors alone not having been found sufficient to give a reasonably constant speed under the violent load fluctuations experienced when operating the electric locomotives.

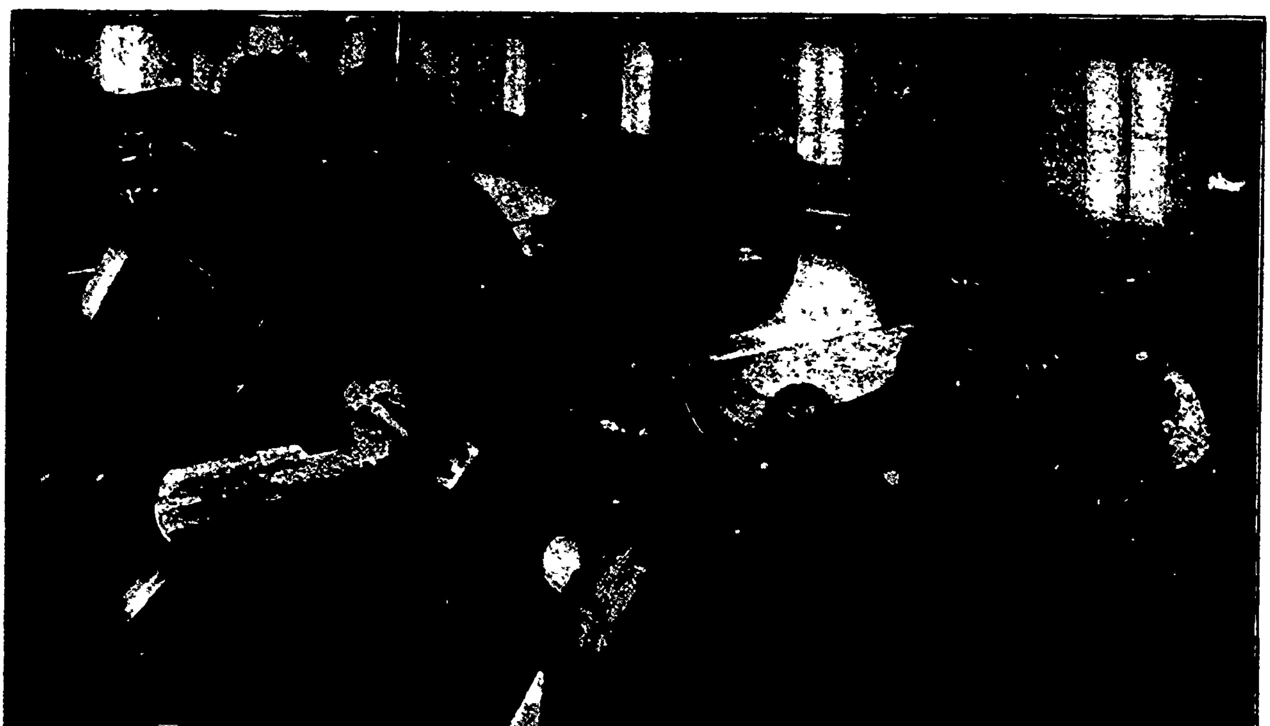
CAR HOUSES.

The car houses located alongside the main line at Deschenes are of stone, and consist of two buildings, each 150 feet long by 70 feet wide; each of these buildings contains four tracks, with pits continued throughout their full length; space is also given for an excellently equipped machine shop and for a tool house, store room and draughting room. A swinging crane is provided over the working pit and hydraulic jacks for handling the motors in the pits themselves.

ROLLING STOCK.

The rolling stock consists of thirteen double truck motor cars, of which four are closed and nine open; also of two single truck 21 foot cars for handling the local traffic in Hull. Four 13-bench open trailers are being added to the equipment this summer. The double truck closed cars are 40 feet 2 inches in length over all; vestibuled at both ends and finished both inside and out in solid mahogany; a special feature in the design of these cars is the use made for an observatory and smoking room of the vestibuled compartment at each end. The equipment for the double truck cars consisted originally of two 50 h.p. motors, but in practice these have not been found entirely satisfactory. The present standard equipment, both for the open and closed cars, consists of four G.E. 1000 motors, geared to run at 25 to 30 miles per hour. This has been found by experience to be an admirable equipment for work of this class. The trucks used are of the Blackwell, Taylor & Brill make.

In addition to the rolling stock mentioned above, which is required for the purpose of handling the passenger traffic, the company operates two electric locomotives, and an express, baggage and mail car, consisting of an ordinary closed body, mounted on double trucks, and equipped with two G. E. 1200 motors. The company has also a Ruggles rotary snow plough, and a snow plough manufactured by the Canadian General Electric Co. A most efficient aid in fighting snow, and one which has proved most effective during the past winter, even with storms that have stalled the steam



Hull Electric Railway—Interior of Power Station.

roads for several days, is the snow plough on each car, designed by Mr. Brown, and shown clearly in the engravings.

Of the two locomotives, both of which are in everyday use on the road, the first, which has been in operation since its starting up, two years ago, consists of a 22 ft. 8 ins. body mounted on heavy Blackwell trucks and equipped with four G. E. 1200 motors, geared to run at 20 miles per hour. The operation of this locomotive has been exceedingly satisfactory, its usual load being five or six loaded freight cars. Locomotive No. 2, which was placed in operation last summer, is a much more powerful machine, the body being 26 ft. in length and the equipment consisting of four G.E. 51 motors, capable of developing 80 h.p. each, mounted on McGuire "L" trucks with steel-rimmed wheels. Several improvements in the form of the body have been introduced, the most important being the lengthening of the cab and the placing of a door and passage at each end. The latter was rendered necessary by the inconvenience and danger experienced in handling the trolley where the ends are of the standard sloping style of the No. 1 locomotive. The No. 1 locomotive is provided with hand brakes only. The No. 2 machine is equipped with Standard air brakes, operated by a motor-driven compressor placed in the cab. The larger locomotive has been found in operation to be an exceedingly powerful machine, as many as thirty-three freight cars having been handled on a shunt; the ordinary load is twelve loaded freight cars. The car bodies and locomotive bodies were manufactured at the shops of the Canadian General Electric Company, by whom the entire electrical equipment used on the road has been provided.

The following statement shows the amount of freight carried, and the nature of the business done by the No. 1 locomotive during its first season. This, it should be remembered, was the first in which business was done and did not include twelve months of time, as the line was not put in operation until during the spring months. A very large increase in this business took place during the second season, rendering necessary the placing in service of a second and larger locomotive.

600 lbs. flour	60 tons.
88,200 bushels of grain	18,000 "
1,500 live stock	500 "
17,020,000 feet of lumber	25,350 "
2,000 cords of fire-wood	3,000 "
Manufactured goods	408 "
Total	47,318 tons.

p.m.), eight for 25c.; red tickets, good between the stations mentioned on Sunday only, eight for 25c.; commutation tickets, giving sixty rides per month, $5 for the first month, $4.60 for the second month, and so on down to $3 for the sixth month, and every subsequent month up to the twelfth; family tickets, 50 rides for $4; school tickets, good only in Aylmer and Hull, forty tickets for $1.

The officers of the road are as follows: President, Alexander Fraser; vice-president, W. J. Conroy;

HULL ELECTRIC RAILWAY—INTERIOR OF CAR.

secretary, W. R. Taylor; mechanical and electrical engineer, J. E. Brown; purchasing agent, E. Seybold; trainmaster, C. Aird.

It is said that the Bell Telephone Company have decided to install a metallic circuit in St. Thomas, owing to the interruption by the operation of the street cars.

The ratepayers of Hamilton have voted in favor of extending the franchise of the Hamilton Street Railway Company for fifteen years, or until 1928. The vote was strongly against the corporation assuming control of the road.

Tenders are invited up to August 30th for supplying an incandescent electric light plant for the corporation of Beeton, Ont. Mr. John Galt, C. E. and M. E., is consulting engineer, and Mr. W. H. Mitchell chairman of the electric light committee.

The Charlottetown, P.E.I., Light and Power Company held its first general meeting recently. Mr. L. L. Beer was chosen president and Mr. Henry R. Lordly, C.E., engineer and manager. Mr. Lordly will go to England to consult with parties who control a new electric motor, to be used for street cars.

HULL ELECTRIC RAILWAY—40 FT. DOUBLE TRUCK ELECTRIC CAR.

An important feature in connection with the handling of freight is the low cost of locomotive repairs as compared with a steam locomotive. An additional and important saving is the greatly reduced cost for cleaners and attendants in the car-house.

The following are the rates of fare charged: Regular tickets, three for 25c.; white tickets (good between Aylmer and Deschenes, Tetreau and Hull, from 6:30 a.m. to 7:30 a.m., and between 5:00 p.m. and 6:30

A company, known as the Metropolitan Electric Company, and represented by Mr. T. Lindsay, has made application to the city council of Ottawa for permission to sell electric light and power within that city. The company offer to supply electricity for one cent per ampere hour, with a discount of 40 per cent., and also a further discount of 12 per cent. for cash within 15 days, off the lowest net meter price. It will be remembered that recently the Deschenes Electric Company were refused a similar privilege as that asked by the Metropolitan Company.

SPARKS.

A company has asked the Dominion government for a subsidy for an electric railway from London, Ont., passing through Stratford, Arkona and Thedford to a point on the Georgian Bay.

An English syndicate has secured a controlling interest in the New Westminster and Burrard Inlet Telephone Company, which operates an extensive system, extending to the United States.

An important contract has recently been made between the Dominion Cotton Company and the Royal Electric Company, whereby the former are to install electricity as the motive power in their works. The contract calls for 1,500 horse power from the Chambly works, with the option of increasing it to 3,000, the contract to run for twenty years.

Experiments are being conducted on a system for telegraphing without wires between Lavernoch Point and Flat Holm Island, in the British Channel, a distance of 3¼ miles. The Morse code of signals is used and the messages are read by sound. It is stated that 40 words per minute have been signaled across and read without any difficulty. The system is the invention of W. H. Preece, engineer-in-chief of the English General Post Office.

The Montreal & Southern Counties Railway Co., which obtained a charter last year, was given power at the last session of parliament to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville, and to increase its bonding powers from $20,000 to $25,000 a mile. Authority is also given to sell electricity for light, heat and power. Mr. Albert J. Corriveau, of Montreal, is the promoter of the scheme.

Mr. R. H. McCollum, son of Rev. J. H. McCollum, of Toronto, has invented an automatic brake for street cars, which was recently tested, with very satisfactory results, by the management of the Toronto Street Railway. The function of this new brake is to automatically work upon the trailer, which at the present time is acted upon by the old hand brake. Owing to the many duties of the conductor, the trailer breaks are seldom used, and the car rushes forward with such force that the trolley is driven ahead, despite its acting brake. With this novel brake, however, the car may be stopped, even with a loaded trailer behind, in a distance no greater than its own length.

Municipal trading in electric lighting fixtures has been declared to be beyond the powers of municipal corporations in England in the absence of legislative authority to that effect. The question arose, according to the London "Surveyor," at Leicester, where the town brought action to recover some $25 from a tradesman to whom it had sold lamps and other fittings. The court decided that since the goods had been furnished they must be paid for, but that the plaintiff should bear the costs, and had clearly exceeded its powers. The town did not restrict its trade to patrons of its lighting plant, which might have altered the case, especially the supplying of lamps. The reasoning used in this decision would doubtless hold good on this side of the water.

Prof. Callendar, recently of the staff of McGill University, Montreal, has designed a platinum electrical resistance thermometer, capable of measuring temperature to the ten-thousandth part of a degree. The extreme delicacy of the instrument makes it a valuable aid in securing accurate observations of the temperature of lake and river water during the various seasons of the year, as no thermometer is available for such minute measurements. A long series of observations of the temperature of the St. Lawrence was made last winter by the McGill professors, in all of which the new instrument was used. By its aid it has been found that the greatest deviation that takes place in the winter during the ice-forming period, is only about one-thousandth part of a degree.

Mr. Henry Symons, Q.C., has had estimates prepared by eminent English engineers on the construction of the proposed works of the Welland Power and Supply Canal Company. This project involves the construction of a canal from the Welland River to the brow of the mountain at Thorold, a distance of 8 miles; the construction at Thorold of a power house, and from Thorold to Lake Ontario, a raceway by which to carry water into the lake. The estimate for the machinery to generate 100,000 horse power is £125,000; for transmission line to Toronto at a voltage of 10,000 and delivery of 50,000 horse power, £801,600; for excavation and other work connected with the undertaking, £1,525,062. The total estimate therefore amounts to £2,452,162, or roughly speaking, $12,000,000. If the amount to be delivered in Toronto is reduced to 20,000 horse power, the project would cost $1,000,000 less.

The directors of the Bell Telephone Company have decided to increase the capital of the company from $3,168,000 to $3,900,000.

John D. Banks, an engineer, of Toronto, committed suicide recently by inhaling gas. Deceased was at one time engineer at the Globe office.

The Western Electrical Construction Company recently commenced business at 210 William avenue, Winnipeg. W. T. Steward and F. Yates are the chief members.

The shareholders of the Montreal Island belt line railway authorized the directors to issue new bonds to the extent of $380,000, and to cancel and redeem the old issue of $300,000.

According to the daily press the Toronto Railway Company has entered suit against the Siemans & Halske Electric Co., of Chicago, for $25,000 for breach of warranty of a generator.

The electric light plant at Tilbury, Ont., owned by Mr. R. H. Smith, was destroyed by fire on July 18th last. The loss is about $4,000, two-thirds of which is covered by insurance.

The town of Brampton, Ont., has given a contract for electric street lighting to Pearen Bros., at $50 per lamp per annum. The latter will install an arc dynamo and probably an incandescent dynamo.

The city council of St. Thomas, Ont., has granted a charter to the Peoples Telephone Co., capital $60,000, to construct a telephone system in that city. The president is Mr. Joseph Mickleborough.

The corporation of Thorold, Ont., is advertising for tenders for the extension of the electric light plant, subject to the passing of a by-law authorizing the necessary expenditure. The estimated cost of the work is $7,161.

A company has been formed, composed of Sir William Van Horne, Senator Proctor, of Vermont, Mr. Alger, secretary United States navy, and others, to develop the water power at Grand Falls, N. B., and transmit electric power north to River du Loup and south to Woodstock.

J. D. Kelly, a lineman employed by the Bell Telephone Co. at Peterboro, Ont., while at work aloft on Charlotte street, came into simultaneous contact with a live electric power transmission wire and a grounded telephone wire, mounted on the same pole, and was instantly killed.

The Bell Telephone Co., of London, Ont., are stated to have responded to the challenge of the Peoples Telephone Co., and lowered their rates. Telephones [illegible]ences have been reduced from $25 and $30 to $20 a year, unlimit[illegible]d for doctors' and dentists' offices from $35 to $25.

TRADE NOTES.

The Babcock & Wilcox Company, of Montreal, have secured the contract for boilers for the new civic electric light plant at Granby, Que.

The Electric Construction Co., London, Ont., are installing a 6 h.p. motor and pump for the corporation of Burlington, Ont., to pump the water for street sprinklers.

W. Doherty & Co., organ manufacturers, Clinton, Ont., have installed two 15 h.p. multipolar type motors made for them by the Electrical construction Co., of London, Ont.

The Robb Engineering Co., of Amherst, N. S., who put in five of their Robb-Armstrong engines for the Halifax Tramway Co., are now putting one in the Union street station of the St. John street railway. It is a 300 horse power tandem-compound, side crank engine, medium feed. The Robb Company are now shipping engines to customers on the other side of the Atlantic. Three have been sent to the Isle of Man, for use by a tram company, and three more to Spain, and a seventh one will be shipped to Liverpool shortly.

The directors of the Brantford Electric Light Company have instructed their manager, Mr. Wyse, to proceed at once to purchase the necessary plant for the extension of the works.

The Eastern Townships Light, Power and Carbide Company has decided to purchase the electric plant at North Hatley, formerly owned by Messrs. Edgar & Roy. The capital stock of the company is $50,000. The officers are: A. J. Gordon, North Hatley, president; W. N. Walley, Sherbrooke, vice-president; Dr. Edgar, North Hatley, general manager; O. Roy, Montreal, secretary-treasurer.

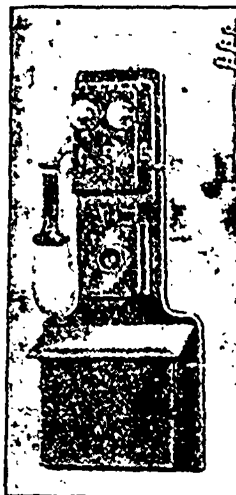
The Ottawa Electric Company will increase their plant at No. 2 power house by adding a 60-inch water wheel and a 125-light arc generator.

The Ontario Telephone and Switchboard Construction Co., Limited, has been incorporated, with a capital of $75,000. It is composed of Messrs. Robert Fox, T. H. Smallman, F. B. Leys, T. H. Purdon, R. A. Bayly, John Labatt, Moses Masuret, John Milne, Dr. J. D. Wilson and J. R. Minhinnick, of London, and H. R. Evans and H. C. Walters, of Detroit.

At a recent meeting of the council of the town of Joliette, Que., Mr. L. A. Herdt, E.E., was appointed consulting engineer to the municipality.

Ephrem Valiquette, president of the Ingeneurs-Mecaniciens Association Canadienne de Secours Mutuels, who was the winner of the gold medal at the Industrial and Mechanical Course at the Monument National, Montreal, is provincial boiler inspector, and also a member of the Canadian Association of Stationary Engineers. He recently left the employ of W. Rutherford & Sons, and was presented on that occasion with a handsome silver water jug, as a token of respect. He is now foreman for Lymburner & Matthews, mechanical engineers, Montreal.

A valuable work has just been issued by Messrs. Longmans, Green & Co., of London, Eng., and New York. It is an exhaustive treatise on the direct current motor, the author being C. A. Carus-Wilson, late Professor of Electrical Engineering at McGill University, Montreal. The aim of the book is said to be to apply the principles of electric dynamics to the direct current motor. Although the discussion of elementary principles is omitted, the different subjects are treated in a very simple but concise manner. It contains over 300 pages, well illustrated and nicely printed. The price is $1.25.



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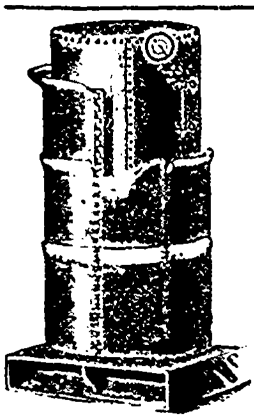

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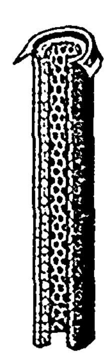

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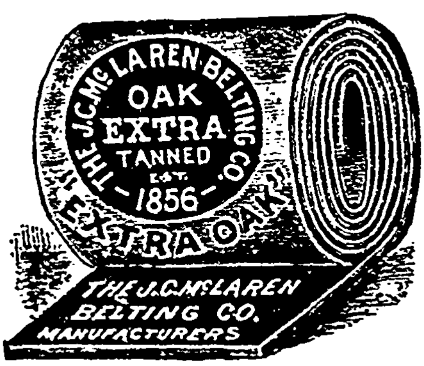

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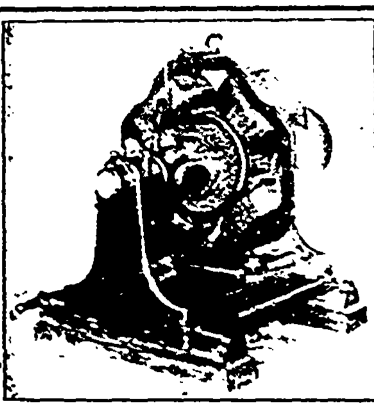

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