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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 4.
NEW SERIES, VOL. III.—No. 5.

TORONTO AND MONTREAL, CANADA, MAY, 1893.

PRICE 10 CENTS
$1.00 PER YEAR.

Please mention the ELECTRICAL NEWS when corresponding with advertisers.

CANADIAN
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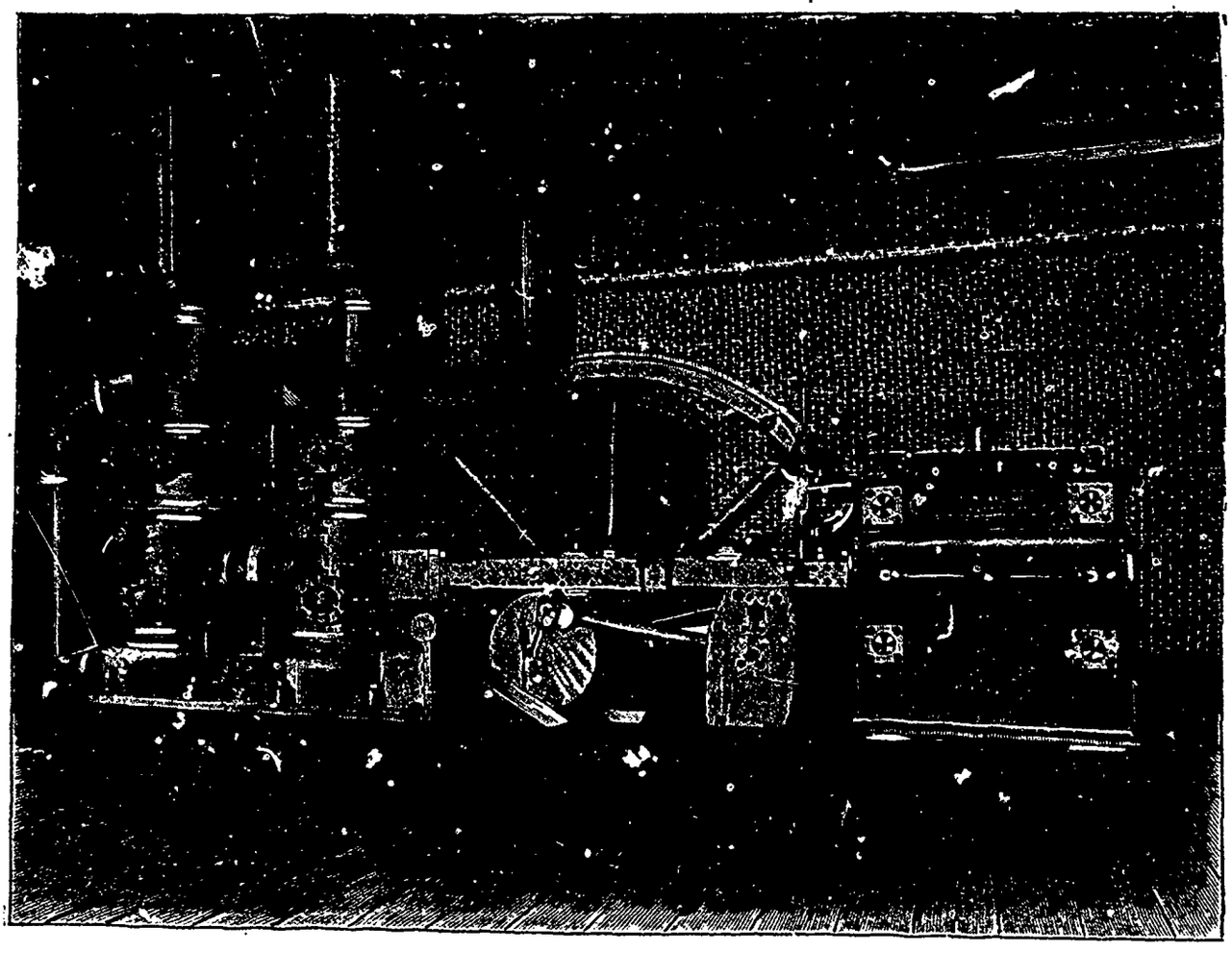
STEAM ENGINEERING JOURNAL.

VOL. III. TORONTO AND MONTREAL, CANADA, MAY, 1893. NO. 5.

DUTY TEST OF NEW BLAKE PUMPING ENGINE AT TORONTO WATER WORKS.

THE following particulars taken from the report of Mr. John Galt, C.E., of Toronto, will be found specially interesting and instructive to engineers and others. The report as a whole is a very able one, and reflects credit on Mr. Galt. The perusal of it will repay the student.

The analysis of the report must be very satisfactory to the city of Toronto and equally gratifying to the designers and builders, The Blake Co., of Boston. We understand that Mr. Keating, City Engineer, has advised the immediate acceptance by the city of the engine, and provision is being made for another similar engine. Although the contract called for a capacity of ten million Imperial gallons in 24 hours, it pumps in excess easily ten per cent. more, giving a duty on an average of 114 million foot pounds for every 100 lbs. of coal burned, equal to a duty of 130 million foot pounds when a similar weight of combustible is considered.



NEW BLAKE PUMPING ENGINE FOR THE TORONTO WATER-WORKS.

The friction or intermediate resistance of machinery, including air pumps, &c., is less than 20 horse power, thus giving a very high efficiency between the steam cylinders and the pumps. The total driving power of steam cylinders, both high and low pressure, is registered at 612.52 horse power, while the resistance of both double acting pumps converted into horse power registers 594.21.

The duty of the steam engine on a basis of combustible consumed, figures at 136 million foot pounds, which is at the rate of 1.45 lbs. per horse power per hour. This, however, takes the most favorable view. Assuming the actual coal burnt and put in furnaces of boiler to be 50,693 pounds, the duty would fall to something under 120 million foot pounds, and the coal to 1.68 lb. per horse power per hour. It is only fair to note in this connection that the percentage of ash or refuse from the coal is reasonably too high, consequently the commercial standard of engine for coal burnt would be somewhere between 130 and 120 million foot pounds. The reduction, however, of duty to a basis of 100 lbs. of combustible actually consumed, is quite legitimate, and forms a scientific basis for comparative reference of other engines and other performances. The report is quite clear on all these points, and not too elaborate, giving all the essential and necessary deductions on a scientific basis.

Mr. Galt has taken into account, we think wisely, the resistance of the pumps in lifting the water from the well level up through foot valves on suction pipe, also suction and discharge valves, &c. So long as pumps require these, it is absurd to disregard their resistance, which is always taken into account on the discharge side of pumps by the careful readings of pressure gauges and the conversion by calculation at frictional head in feet.

The pump valves, &c., are well designed, and contain large area for the speed run at, and the allowance referred to above tallies exactly with the readings of indicator cards, viz.: 105 lbs.

total average working pressure, which gives an absolute frictional head of 242.22 feet.

During the test of two days everything worked smoothly and well. The engine, which is cross compound, direct acting, with two double acting pumps, appears to be designed on good sound principles, and will doubtless take its place among the best anywhere. The capacity size is a specially good standard, viz., 10 to 12 million gallons per day, and with perfection of details will come a perfect machine. The illustrations of engine will assist the reader in studying and understanding the machine.

The particulars of the test are as follows:

PRINCIPAL DIMENSIONS OF ENGINE.

STEAM.

4 multitubular boilers 6'x6", with 110 3" tubes, grate surface each	26 ft.
One high pressure steam cylinder, diameter	29 ins.
One low pressure steam cylinder, diameter	58 ins.
Steam piston rods, crank end only, diameter	5⅛ ins.

WATER.

2 water plungers, double acting, each diameter	20 ins.
Plunger rods, crank end, diameter	4¼ ins.
Length of stroke	48 ins.
Valves, suction and discharge, 64 in each set, diameter	4 ins.
Effective area of valves, each set	411 sq. ins.
Air pump, single acting, 26" diameter, stroke	12 ins.
Feed pump, 7" diameter, stroke	6 ins.

DATA OBTAINED DURING TEST.

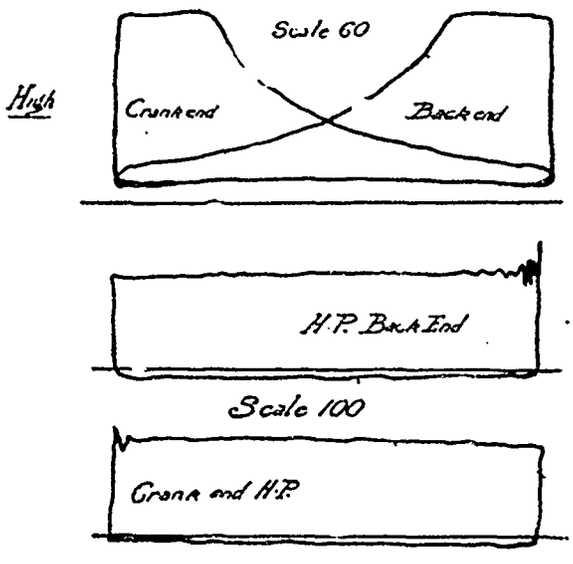
Test began February 16th, 1893, 10:22 a.m. } Duration, 49 hours .08 min.
Test finished February 18th, 1893, 11:30 a.m. }

Total revolutions as per counter	112,838
Average revolutions per minute	38.276
Average working per minute	38.288

3 steam boilers only in use:

Total area of fire grate surface	78 sq. ft.
Wood burned in starting fires 700 lbs. =	280 lbs.
Coal put in furnaces during test	50 413 lbs.
Gross total weight	50,693 lbs.
Refuse, ashes, cinder and percentage of unburned coal	6,910 lbs.
Total combustible consumed	43.783 lbs.
Per cent. of refuse	13.6
Coal burned per sq. ft. of fire grate per hour	13 23
Average steam pressure at boilers	117 lbs.
Average steam pressure in engine room	114 lbs.

	M.E.P.	H. P.
High pressure piston, back end, as per cards	48.80	148 96
High pressure piston, crank end, as per cards	47 87	148 60
Low pressure piston, back end, as per cards	31	162.51
Low pressure piston, crank end, as per cards	50	152.45
Total horse power of steam cylinder		612.52



Average barometric reading	29 703
Average temperature of atmosphere	13.3 F.
Average temperature of boiler room	63.
Average temperature of engine room	70.03
Working length of stroke	47.8 ins.
Average speed of piston and plungers, lineal ft. per min	304.94
Average working " " " " "	305 ft.
Average pressure on force main.. engine house press. gauge	96 lbs.
Average vacuum on suction pipe gauge in ins	9.3 ins.
Vertical dist. of suction pipe below press. gauge	5.5 ft.
Average dist. lift from well meas. to press. gauge	14.91 ft.
Average temperature of water in well	33.3° F.
Average temperature of city mains	35° F.
Average temperature of feed water to boilers	148° F.

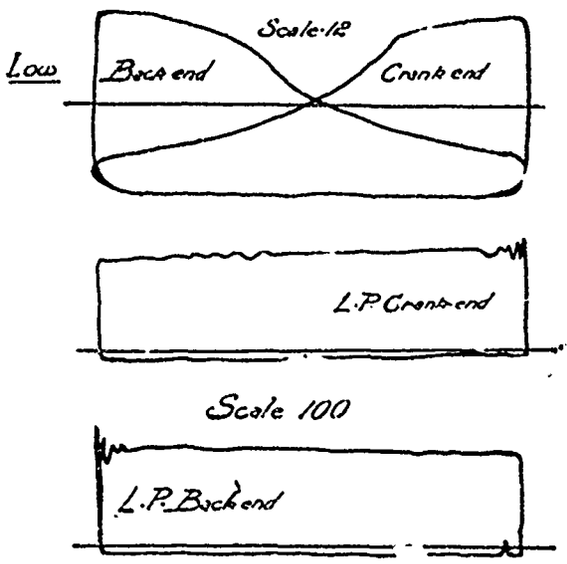
	M.E.P. Press.	Horse Pr.
Water plunger h. p., side, back end, as per cards	103.40	149.53
Water plunger h. p., side, crank end, as per cards	103.50	142.65
Water plunger, low press., back end, as per cards	106.50	154.55
Water plunger, low press., crank end, as per cards	107.00	147.48
Total horse power for pump plungers		594.21

Friction = 612.52 − 594.21 = 18.31 horse power = 3%.
Efficiency of pumping engine 0.79

RESULTS.

Imperial gallon, standard vol., Act of Parliament, 1825 =	277.274 c. in.
Imperial gallons in 1 cubic foot	6.2321
Weight of one cubic ft. of water at 35 F.	62.422 lbs.
Weight of one standard gallon	10,061 lbs.
Pumps, theoretical displacement, per rev. $\frac{306.21 \times 191.2}{277.274}$	211.154 gals.

Average revolutions per 24 hours = 55.117.98 = 38.276 revolutions per min.
Working revolutions per 24 hours = 55.134.64 = 38.288 revolutions per min.
Difference due to starting and stopping slowly.
Total water pumped, theoretical displacement 23,826,200 imp. gal.
Capacity of pumps in 24 hours = 211.154 × 55.134.64 × 11,642,000 gallons.
Commercial capacity in 24 hours = 11,642,000 gallons,
less 4% = 11,176,000 lin. gals.



Duty calculated on different basis.

Average reading of pressure gauge	96 lbs.
Average reading of suction gauge $\frac{9.26 \times 34.295}{7000}$ =	4.6 lbs.
Average pressure in remainder of suct. pipe, also suct. valves	1.0 lbs.
Average pressure in discharge valves	1.0 lbs.
Add pressure for 5.5 ft. vertical distribution from suction valve gauge to pressure gauge	2.4 lbs.
Average working pressure on plunger as per reads	105 lbs.
Average working pressure on plunger as per cards	105 lbs.

Calculated head resistance $\frac{105 \times 154}{62.422}$ in feet = 242.22 ft.

Duty of engine on coal consumed per 1 horse power per hour $\frac{43.783}{49.133 \times 612}$ = 1.45 lbs.

$\frac{33.000 \times 60 \times 100}{1.45}$ = 136,000,000 lbs

Weight of steam per h. p. per hour, as per indicator cards.. 13.94 lbs.
Equivalent evaporation at boiler per lb. of combustible consumed under actual conditions $\frac{13.94}{1.45}$ = 9.8 lbs.

Standard equivalent from and at 212° per lb. of combustible consumed = 9.81 × 1.05 = 10 30 lbs.

Commercial duty at pump for every 100 lbs. coal put in furnaces:

By work $\frac{\text{area} \times \text{lbs.} \times \text{H.} \times \text{Rev.}}{\text{lbs.}} = \frac{306.21 \times 105 \times 15.94 \times 112.838 \times 110}{50,693}$ = 114,078,000 ft. pounds.

By gallons $\frac{23,826,200 \times 10.0126 + 242.22 \times 100}{50,093}$ = 114,031,000 ft. pounds

Commercial duty at pump calculated for every 100 lbs. of combustible consumed $\frac{\text{average lbs. coal}}{\text{lbs. combustible}} = \frac{114,055,000 \times 50,693}{43,783}$ = 132,056,000 ft. pounds.

PUBLICATIONS.

The April *Arena* contains a strong paper by Hamlin Garland on "The Future of Fiction." Dr. Alfred Russell Wallace writes on The Wage-Worker and how he may be delivered from the Social Quagmire. W. D McCrackan discusses "How the Initiative and Referendum may be Introduced into our Government."

Messrs. D. VanNostrand & Co., of New York, have published, in connection with their science series, an interesting little work on the measurement of electric currents. The book, which is illustrated, is made up of two valuable papers, "Electrical Measuring Instruments," by James Swinburn M. Inst. E. E., and "Meters for Electrical Energy," by C. H. Wordingham, Assoc. M. Inst. E. E. The writers deal with their subjects very comprehensively, and the book will be found to be a very useful one.

LEGAL DECISIONS.

As this issue of the ELECTRICAL NEWS is about to go to press we learn that Chief Justice Galt has quashed the by-laws of the cities of London and St. Thomas granting exclusive privileges to the Bell Telephone Co. The Bell Telephone Co. have appealed from the decision.

EQUIPMENT OF ELECTRIC CARS.*

By E. C. Westcott and E. Craig.

If we cast a glance at the electrical industries in our city six months ago, and compare them with those now existing, we cannot but realize what important and gigantic steps have been made in so limited a time. At that time Montreal employed hundreds of arc lamps, brilliantly illuminating its thoroughfares, while the incandescent lamp could be counted by thousands, lighting residences and stores. Motive power was also then distributed on a limited scale. To these has been added a safe, comfortable and speedy mode of electric transportation.

It is not the aim of this paper to treat all details connected with electric traction, nor even to consider its essential elements. We shall only examine to a certain extent the electric equipment of the cars, making mention of the varying characteristics of the different types to be found in our streets, and the necessary starting and regulating devices pertaining to each system.

The most striking resemblance which characterizes the four different types used, is the laudable practice of imbedding all armature conductors in grooves cut in the armature core for that purpose. Two of the types of motors are so nearly alike as not to need a different treatment, the most striking resemblance being that one is built in Montreal, while the other is a native of Lynn, Mass. Each armature is of the Gramme ring type, the former being wound with ordinary wire and connected to commutator in the usual way. The latter is wound with copper ribbons of such width as to just fill the grooves in which they are placed. A piece of ribbon is fastened by a rivet to the loop between the sections so as to connect same with commutator. *These grooves are so shaped that after the winding is finished* there is a space left, which is filled with a wooden wedge to keep the ribbon in its place, thus doing away with bands, and affording a better protection to the winding.

The most popular construction is known as the "iron clad," which carries the existing coil on the top pole, thus preventing any moisture which might collect at the bottom of the car, from harming it. The armature and field coil are easily replaced in case of a burn-out. The pole pieces of the former are built up of sheet iron, being placed in the mould before pouring, while in the T and H the pole pieces are cast solid with the yoke. We are informed that a secret process is employed for making the metal in which they are cast.

The Edison motor also has a Gramme armature, differing from the others in that it depends on bands to hold the winding in place.

The winding is done in the usual way, the commutator being cross connected so as to allow of placing the brushes at 90 degrees, in the proper neutral field. It has a four pole field of the iron-clad type, with two field coils placed on opposite poles, and has therefore two consequent poles. The castings are of steel and are made in four pieces, bolted together. These motors are not waterproof, but when covered with canvass which is very easily done, they are very durable.

The last motor which we have to examine is in no respect similar to the others with the exception of the field and armature, which are in grooves. The armature is of the drum type, rotating in a field of four poles. The coils of this armature are wound on taped forms, and afterwards placed in the grooves before mentioned, the ends of same being brought out one section less than 90 degrees apart, instead of the usual style of drum winding. In connecting the commutator, the two ends of each coil are placed in one segment, less than 180° apart. This arrangement has the advantage of having two circuits and overcomes the necessity of having four, and cross connected commutator bars, as in the previous cases was necessary, or there would be an unsafe difference of potential; a cause of trouble, and in doing which there would be no sacrifice of simplicity of construction nor of ease in repairing and replacing damaged coils. In this last case the coils have been wound in a form and then bound with tape before being placed in their respective grooves and it is an easy matter, requiring very little time to remove a number of such coils and if required replace them with new ones.

All of the foregoing motors are series wound, having so many turns that even with a small current they can saturate the field sufficiently to give the armature torque enough to start, even under load. It is a practice with the Edison and T. H. motors, to cut some of the coils after all outside resistance has been short circuited.

The Edison cars in this city have been equipped with the combined rheostat and controller of Thomson-Houston make, being an exception to their general practice of commutating the fields. In order to keep an excessive current from blowing in the motors there must be sufficient counter E. M. F. generated in armatures which is itself dependent on speed and saturation of field; or there must be necessary total resistance provided. If certain devices affecting the necessary field strength changes, are employed, they will prove very beneficial, providing they do not bring such complications as to be sources of trouble. The Edison commutation of fields has a two fold end— while having the property of altering the strength of the field it at the same time alters the total internal resistance of the motor.

The object in view is obtained by winding the coils in sections, (as a rule three, and of an unequal resistance), and having on both platforms a controller in the form of a cylinder on which a certain number of brass pieces have been fastened in such position and of such shape that rotation of cylinder brings these peculiar shaped pieces under the different stationary contacts to which the individual terminals have been brought.

The position of cylinder will cause the circuit to be completed through one of the following combinations, that is, three coils in series with an indispensable outside resistance; the coils in series and rheostat short circuited; leaving two only in circuit, the coil just short circuited placed in shunt to one out of the series; the last coil of the series short circuited; and lastly, the last named coil placed in multiple with the other two. But the advantages of such a devised system lead to a great complication of wiring and introduces the reasonability of making field coils cores a place to build the rheostat.

In the T. and H. system, the motors are controlled with one controller and are connected with controller's handles at both ends of the car by means of steel cable threaded through pulley sheaves. Although the rheostat and controller are combined in one, saving a large amount of wire which would have to be used otherwise, yet the advantages pertaining to having an independent controller at each end more than compensate for the saving of wire in the fact that it is almost impossible for both controllers to break down at once.

The Westinghouse rheostat is made of spiralled wire divided into five sections, five contacts being placed on rheostat box in such a position as to be easily accessible for connecting the wires from controllers. The controller consists of a cylinder having six brass pieces of varying length attached, which are *for cutting in and out the rheostat sections. The longer of* these makes contact with the first section of the rheostat on turning the cylinder, the rest following according to their length. The reversing switch is placed on the same cylinder, consisting of six contacts, two of which make contact with the ground field respectively, the other four being cross connected in such a manner as to reverse the current in the armature, the direction of which is determined by the direction in which the cylinder is moved, the controller contacts acting the same in either direction.

The greatest troubles that have been experienced with the cars, are the giving out of armatures and field coils, which are traceable in the majority of cases to the most unfavorable conditions to which they are subjected. It is certainly not the purpose of electric machinery to be run in water, but many a day this is almost the case. The best remedy is unquestionably to replace the damaged part, but to prevent the trouble is rather more difficult, although judging by what one reads in periodicals regarding receipts for overcoming moisture and water-proof paints, preventives seem to be within reach. If such paint were obtainable, and the design of motors was such as to admit of all wire being out of the reach of water, care being taken to keep the car from wide differences of temperature, it would certainly help a great deal and save a great number of burn-outs. The fact that the series wound motor is being used in almost all cases, in preference to the shunt motor so successful in stationary work, may lead to questions regarding the reasons of such practice. Perhaps the unreliability of the supply reaching the machinery through the dirty rails and the shivering trolley may account for it to a certain extent, as every time that the circuit is opened, the field will lose its saturation. An armature without counter E. M. F. is practically a short circuit, but this could certainly be obviated without much complication by having automatic devices in the armature circuit which would let current flow only as long as the field was saturated. Another consideration very objectionable, is that of having 500 volts of pressure between the terminals of the field coils. Also with the cars the constancy of speed being of no consideration and impossible the great advantage of shunt motors would be lost.

There is good reason to think that in the near future the alternating motor of single phase will be made self starting and of sufficiently powerful torque to make it adaptable for traction purposes. When that has been realized, the ideal will be reached, for the armature of the motor would be merely a number of copper bars not necessarily insulated from the core, and all short circuited at the ends on flanges and without a commutator, while all the regulating devices required would be the reactive coil, not even reversing switches being needed. Trolley cars will not then require a higher pressure than 100 volts.

Owing to advantages to be secured by the use of transformers, currents can be generated at distant points where power may be had for a minimum cost, but this is not very important when we remember that the fuel expense is no more than 10% or 15% of the total expenditure.

* Paper read before the Montreal Electric Club.

CORRECTION.

The Doty Engine Co. advise us that they constructed the breeching in connection with the power plant at the Toronto Street Railway Company's power house, and not Mr. John Abell, as stated in our last issue. The error was due to our having been mis-informed. We take pleasure in now placing the credit for this excellent piece of work where it properly belongs.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of the various Associations are requested to forward us matter for publication in this Department before the 10th of each month.

ADVICE TO YOUNG ENGINEERS.

(By Bro W. J. Rhodes, Pres. Berlin No 9, C. A. S. E.)

For about twelve years I have been learning my trade,
And don't claim to know it all yet;
But have learned a few things by the blunders I've made
That I'll not very soon forget.

Experience is a good, though very dear school,
But we needn't all learn things that way—
From books and good papers we may learn some good rules,
And will have less tuition to pay.

While speaking of rules, let me give you just one
On which you can always depend:
In steam engineering the less risk you run,
The better you'll come out at the end.

You may oft hear it said, "no risk no gain,"
But it won't do to risk much with steam,
For it's risky enough; so be sure of your run,
As you would with a runaway team.

Don't run any risk. If your pump doesn't throw,
Stop, while you have water in sight,.
The boiler *may* stand it, but that you don't know,
It may blow you as high as a kite.

Men often gain time by just going slow.
But many dear lives have been lost
By going by guess, when facts they should know
Could be had at a trifle of cost.

Now just one thing more! when your day's work is done,
Before from the boiler house you retire,
If with water and steam no risk you have run
Be sure you run none with the fire.

Don't run any risk, boys, unless
It's with something you can't make secure,
Don't do any work by the rule of "I guess,"
When the facts you can easy procure.

Have some little pride as to how your place looks,
And whatever you do, do it right—
Have plenty of tools and plenty of books,
And don't run around much at night.

And now my dear boys, of all that I've said
I hope you'll remember the text,
Don't run any risk, and you'll come out ahead;
I'll tell you the rest in my next.

ORGANIZATION OF BERLIN ASSOCIATION NO. 9.

AT a preliminary meeting of stationary engineers held in Berlin, Ont., April 8th, it was decided to organize a branch of the C. A. S. E. on Saturday, April 22nd. This decision was the result of some missionary work done by Bro. John A. Angell, District Deputy and President of Guelph No. 6, who was assisted in the work in a most able manner by Bro. W. J. Rhodes and several other engineers of Berlin.

Bro. Angell had applied to the Executive Council for, and had received the charter for the new Association, (which will be known as Berlin No. 9, C. A. S. E.) and had instructions to proceed with the organization, but unfortunately a few days previous to the day appointed, was taken very ill and thus was unable to finish the work he had so well begun.

The news of Bro. Angell's illness was communicated to A. E. Edkins, President of the Executive Council, with the request that he should visit Berlin and complete the work of organization, which he did, being accompanied by Bros Jordan, Green and Tuck, of Guelph No. 6.

On arriving at Berlin the visitors were met by Messrs. W. J. Rhodes, A. Vice and Geo. Steinmetz, who conducted them to the Commercial hotel.

At 8 o'clock the engineers interested began to arrive, and at 8.30 the meeting was opened by Bro. Edkins, who was requested to lay before those present the objects of the Association. This he did in a brief speech, laying particular stress on the need of such an organization in every manufacturing town in Canada, as it would not only prove beneficial to the engineers, but even more so to the steam users. By raising the standard of the engineering knowledge of its members, it would certainly follow as a natural result, that the employer's plant would be kept in a greater state of efficiency. Steam users, he said, were prejudiced against the Association at first, but the majority of them now appreciated its work. There were some engineers even, who were, as they themselves put it, "down on the Association." Some of these men were good engineers and mechanics, who would be a credit to the organization, but who for some reason or other, had formed a wrong impression of it. Then there was another class who, when asked to become members, would inform you, with a deal of wind and blow, that they know all they *want* to know of engineering, and therefore could not learn anything themselves by joining the Association, and were certainly not going to come up to the meetings and tell all they had learned during their long and varied experience. If the truth were known, this class of men would gladly become members, but for the fact that they are fearful lest they should be asked for information on some subject, which they could not give, and that would make them appear ridiculous in view of their previous boasting. It was a pity that men acted in this manner, for the chief object of the Association was to assist its members to become better engineers. He hoped the day would never come when they would "know it all." The election and installation of officers was then proceeded with, and resulted as follows:—

President, W. J. Rhodes; Vice-Pres., Alf. Vice; Rec. Sec. Geo. Steinmetz, Berlin post office, Ont.; Treasurer, Henry Snider; Fin.-Sec., John Fennell; Conductor, Abram McKessie; Doorkeeper, Wm. Fiedt.

About 15 charter members were initiated, and several other engineers have signified their intention of joining.

A vote of thanks was presented to the brethren from Guelph and Toronto for their kindness in being present, and the hope was expressed that Bro. J. Angell might be speedily restored to health, and be enabled to visit No. 9 in the near future.

ANNUAL DINNER OF HAMILTON NO. 6.

The above Association held their sixth annual dinner on Thursday, 30th March, at the Commercial hotel. About 100 of the members and their friends surrounded the tables in the fine dining room of the hotel, and were well pleased with the delicacies which mine host Maxey and his staff of waiters placed before them.

The chair was occupied by Bro. Wm. Sweet, President of the Association, and the vice-chairs by Bros. W. Norris and A. Nash. On the removal of the cloth the chairman welcomed the members and guests on the occasion of their annual reunion, and bespoke for all a pleasant time. He then proposed the toast of the "Queen and Royal Family," to which the company responded by singing heartily the National Anthem.

The "Army and Navy" brought forth a response from Bro. Thomas Carter, a veteran.

Mr. H. N. Thomas sang "The Longshoreman," and received such a hearty encore that he favored the company with "Hearts of Oak"

"The Dominion Parliament" was responded to by Mr. Jas. Weir, of the Inland Revenue Department. The speaker claimed that Canadians had at Ottawa representatives who could hold their own in point of ability with any in the world.

Prof. Cline sang "The Maple Leaf."

"The Ontario Legislature" was received with loud applause. Brother Duncan Robertson responded. He expressed regret that the Hon. J. M. Gibson, at the last moment, had been prevented from being present. He was sure that that gentleman would be gratified if he knew the kindly feelings which the engineers cherished towards him for services rendered the Association. Not only the members but the community at large owed the Hon. Mr. Gibson and the Ontario Government a debt of gratitude in this connection.

Mr. Thomas Jones sang "Farmer Magee."

"The Electrical Engineers" was responded to by Mr. Wells. Prof. Cline sang "The Old Red Cradle." "The Mayor and Corporation" was ably responded to by Ald. A. D. Stewart. He referred to the importance of the Association of Stationary Engineers, a body of skilled artisans, without whose services the public would fare badly. The toast to the "Manufacturers" was replied to briefly by Mr. McKeown, followed by a song "Cockles and Mussels," by Ald. Stewart.

"The Press" was acknowledged by Mr. Buchanan, of the *Times*.

Mr. Thomas James sang a comic song.

"The Canadian Association of Stationary Engineers" was responded to by Bro. A. M. Wickens. He said he was proud of the organization, and there were a great many reasons why he was proud of it. He referred to the brainy men who had been engineers in Canada in the past, one of whom had built the first steamship to cross the Atlantic, and it was constructed of Cana-

dian materials, too. He mentioned the names of Edison and Bell, Canadians who had distinguished themselves in engineering science; and there were many others as well. A little over six years ago the Association had been founded in the speaker's dining room in the city of Toronto, when there were just eleven men present. Now a chain of branches extended from Ottawa to Winnipeg. All of these were doing good work.

"Prof. Cline sang the "Cameron Men."

"Our Sister Associations" was responded to by Messrs. Wier and Bates. Both reported that the Association in Stratford was flourishing and the demand for men holding certificates was increasing.

Mr. Thomas Lewis of the rolling mills, dropped in and favored the company with a couple of his inimitable songs.

"The Honorary Members" was responded to by Bro. Duncan Robinson.

Songs were sung by Messrs. P. Casey and J. Church. Bros. Langton and Johnson responded on behalf of "The Ladies."

"Our Host" was acknowledged in a neat speech by Mr. Maxey.

After one or two volunteer toasts, and the singing of a few more songs, the merry evening was brought to a close with "Auld Lang Syne" and "God Save the Queen." Mr. Thomas Baine played the accompaniments for the several singers during the evening in a very acceptable manner.

Toronto No. 1 held its regular meeting on April 14th, W. G. Blackgrove, president, in the chair. Mr. Edkins read a portion of Desmond's Electricity and a general discussion followed. There was an exceptionally large attendance of members. Three new candidates were initiated and one proposal received. The officers for this Association for the ensuing year are to be elected on June 23rd next.

Guelph No. 6 met on the 15th ult. The President read a paper on "Lining up an Engine," which was great appreciated by the large number of members present. One new candidate was initiated.

Mr. W. G Blackgrove, Secretary of the Executive Council, has removed from 43 to 45 Brant street.

QUESTIONS AND ANSWERS.

Member C. A. S. E., Guelph, asks:—

1. Does the fly wheel increase the working power of an engine?

2. Will the drive wheel have the same effect on the engine as an idle fly wheel of equal weight and diameter?

3. If raising a safety valve will cause water to leave the bottom of the boiler, what effect will blowing the whistle have?

Ans.—1. A fly wheel does not increase the working power of an engine. It acts as a reservoir of power. Power accumulates in it as its speed increases and is given off by it as its speed diminishes.

2. A drive wheel will act efficiently as a fly wheel if made heavy enough and of sufficient diameter.

3. Raising a safety valve allows *some* steam to escape, and so does blowing the whistle. If letting some steam escape from a boiler raises the water off the bottom of the boiler how is it that a steam engine can be run in connection with a boiler? Every time the engine valve opens some steam escapes from the boiler, and according to the supposition in the question the water ought to go too! Does it?

H. F. Thompson, Recording Secretary Montreal No. 1, C. A. S. E., asks:—

What qualifications must a man have to permit him to write after his name the letters M. E., and also the letters E. E.? M. E., in this case, stands for Mechanical Engineer, and E. E. for Electrical Engineer.

Ans.—The letters M. E., standing for Mechanical Engineer, may in this country be appended to any man's name who thinks himself entitled to use them. The same with the letters E. E., standing for Electrical Engineer. So far as we know, the law of the land takes no cognizance of these letters as it does of M. D. and sundry others, and till the law defines who alone may use them, every one who meddles with engines may call himself an M. E., and every egotistical idiot may write E. E. after his name if he can.

THE COMPLAINT OF A MOTORMAN.

TORONTO, April 4th, 1893.

Editor ELECTRICAL NEWS.

SIR: I am employed by the Toronto Railway Co., as motorman, and have been a very diligent student of electricity as a motive power since its introduction in this city. The company will not even allow us, however, to replace the plugs, when they are blown, but we have to wait for the next car to push us to the shop, causing worry and delay to passengers as well as motormen. There are men employed by the company, calling themselves "inspectors,"—men who worked in the shop for probably three months, and who have the audacity to rank themselves with experts, but who in reality do not know the first rudiments of the work they are engaged in. These men and the roadmaster (who probably never ran more than three trips on an electric car) are only allowed to replace the plugs or do other temporary repairs, while motormen, who have been driving motor cars since their introduction, and know the different causes of obstruction, are unable to use their knowledge. I give you an illustration which happened to me about two weeks ago: I was training a man to run a motor, and among other things took up the floor to show him one of the machines and explain to him the different wires on the motor board as well as my scant knowledge would permit, when one of our lordly "inspectors" swooped down on me and asked me any right to interfere in his business. I told him very politely but firmly that although I would not interfere with the machine in his charge, I would take up the floor as often as I liked for my instruction as well as for the information of those under my guidance. Is not this amusing? If this letter could meet the eye of some of the officials, which I hope it will, I would respectfully submit the following for their consideration:

1. To employ only the most intelligent men as motormen.

2. To authorize six mortormen on each line to make temporary repairs in passing obstructed cars; this will do away with inspectors who, like policemen, are never to be found when wanted.

3. In course of time every motorman will be his own inspector. This would reduce expenses and would increase the efficiency of the service 50%. Until such time as some such course as this is adopted all the information we could gain from your instructive paper would be useless so far as its practical application is concerned.

In a discussion among motormen, last Saturday, as to the merits of your paper they were favourably impressed with its contents, but emphatically refuse to subscribe until the company's mode of procedure is reversed, the motormen treated as intelligent men should be, not as block-heads.

Respectfully yours,

HOWARD W. STANLEY,
Motorman Toronto Ry. Co.

HAMILTON.

(Correspondence of the *ELECTRICAL NEWS.*)

This little city will be the scene of great activity very shortly in an electrical way, for in spite of the assurance of the managers of the Hamilton Street Railway Co. that their old rails would do them a couple of years longer, they now find that they must all be renewed, which will involve an outlay of many thousand dollars, but they will save in the end, because the rails now are pounding the life out of their motors in more ways than one. They have also made a start at a cross town road to run to the G. T. Railway station, and have commenced grading and tracking a mile and a half extension to the new fair grounds and race track. They are having several new cars built with which to equip these extensions, and are putting in a new Corliss engine and Westinghouse generator for the same purpose.

You have perhaps heard of our little extravaganza here in the shape of "Ye Olde English Fayre" which came off in the drill hall, and in which was installed by the Hamilton Electric Light Co., some 11 arc and 100 incandescent lights. It was well patronized and enjoyed thoroughly, and is something to be remembered in more ways than one, but from an electrical point of view, particularly, as our friend Cochrane, the well known photographer, with his usual vim and push, had a full fledged photograph gallery rigged up and did a rushing business, even at night time, with four 2000 c. p. arcs to take the place of daylight. The work turned out was excellent, and as good as any produced by daylight. It was quite a novelty and took well.

I must also tell you that one of our enterprising grocers is now serving out as samples, pan cakes cooked on a little electric griddle, and they are perfection as far as the cooking is concerned.

The Hon. Senator Sanford has some 300 incandescent lights in his private residence in this city.

John Calder & Co., wholesale clothiers, have just had 136 incandescent lights put in their establishment, together with an electric motor to operate their elevator.

There is some talk of installing an arc light plant at the Beach this summer to light the hotels and a summer theatre which it is proposed to erect there, and perhaps the road for a mile or so.

We had a call from our genial friend, Mr. D. A. Starr, of the Royal Electric Co., Montreal, who it is perhaps needless to say, shines as bright as ever. Mr. C. W. Henderson, the electrical supply man, of Montreal, also gave us a call a few days ago, and is up to the neck in business. He took away one or two orders with him, and is pleased in consequence.

The Eagle Knitting Co. have placed an order for a 10 h. p. motor to operate their works, employing some 200 hands.

ELECTRI-CUS.

The Bell Telephone Co. have obtained an exclusive ten years' franchise at Ottawa for $1,500 a year.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

PUBLISHED ON THE FIRST OF EVERY MONTH BY

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OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.
64 TEMPLE BUILDING, - MONTREAL.
Bell Telephone 2299.

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

SUBSCRIPTIONS.

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

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

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

EDITOR'S ANNOUNCEMENTS.

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

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

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

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KINGSTON, ASSOCIATION STATIONARY ENGINEERS.—Meets twice each month over No. 1 Fire Station. J. Devlin, President: W. Gilmour, P. O. Box 699, Secretary.

IT is gratifying to us to observe that the invitation which was recently extended through these columns to engineers to ask for information through the "Question and Answer" department of this journal is being responded to. Several answers to questions thus submitted are published in the present issue, and we would be pleased to see the number increase. In this way much valuable information may be disseminated. We would be pleased if our readers would not only ask for needed information, but also when possible supplement our answers by any additional information on the subject which they may be in possession of.

THE Executive Committee of the Canadian Electrical Association is taking time by the forelock in regard to the arrangements for the second annual meeting to be held in Toronto next September. The promises of several papers for that occasion have already been secured from members of recognized ability. It is expected that the full number of papers required will very shortly be arranged for and be in course of preparation. A meeting of the Executive Committee will be held on the 17th inst. for the purpose of forwarding this and other arrangements for the convention, which it is expected and believed will surpass in attendance and interest any that has yet been held. Every member of the Association is urged to endeavor to increase the membership, and in every possible way to assist its progress and practical usefulness.

THE members of Toronto No. 1, C. A. S. E., have introduced an interesting feature in their meetings. They have taken up for study and discussion Electricity. A member reads a chapter from an authority on the subject, after which the question is discussed in all its bearings by the members. This practice should be the means of making the gatherings of the association more attractive, while affording opportunities to the members to become acquainted with a subject which, next to that of steam engineering itself, applies most closely to their calling, and exerts the greatest influence upon their material interests. The fact is becoming increasingly apparent that the engineer who neglects the study of electricity will soon find himself placed at a serious disadvantage as regards ability to obtain and hold the best positions.

WE learn that active preparations have already been commenced by the engineers of Montreal for the annual convention of the Canadian Association of Stationary Engineers which is to be held in that city early in the autumn. The Montreal City Council has granted $300 toward the cost of entertaining the visiting delegates, and has also given the free use of the City Council Chamber for the meetings. It is expected that the manufacturing firms of the city will contribute liberally for the purpose of making the occasion one of much pleasure and interest. It is hoped that liberal arrangements can be made with the railroad companies, such as will enable a large number of members from the western cities to attend. Perhaps the best arrangement would be for the Association to charter a car for the use of these members, as many as possible of whom will go if the rates are reasonable. At this convention a number of papers of much interest to engineers will be read and discussed. Everything points to a successful meeting.

IN our correspondence column we publish a communication received from a motorman in the employ of the Toronto Street Railway Company, complaining of a grievance existing among his fellow workmen. At an interview with an official of the company in reference to this letter, we were given to understand that it is their intention to encourage among their motor men the study of electricity as a motive power, and how this can best be done is to be considered at an early meeting of the directors. Our correspondent must bear in mind that when the motor

cars were first run on the streets in Toronto it was necessary to have regulations of the nature he mentions in order to prevent incompetent men from interfering with the machinery or else import experienced men from places where cars had been running for some time, in other words American labour would have had to be resorted to. There is no doubt that it is to the company's interest to satisfy this desire for knowledge among the motormen in their employ. THE ELECTRICAL NEWS would be pleased if in any way through its columns the object sought might be promoted.

THE list of new subscribers to THE ELECTRICAL NEWS during the present year is gratifyingly large. About two hundred new names have been received since the first of January, and these have come from all parts of the Dominion. Such a liberal measure of appreciation will stimulate us to raise the standard of the paper's interest and usefulness to the highest possible degree. There are three ways in which we would be pleased to have the assistance of every reader: 1. Endeavor to send us at least one new subscriber each year. 2. Contribute as frequently as possible information to our columns. 3. When in need of electric or engineering supplies, consult our advertising pages, write our advertisers for what you require, and when doing so mention the fact that you saw their advertisement in the ELECTRICAL NEWS. If you do not find advertised what you require, write us to that effect, and we will immediately put you in the way of getting it. It need scarcely be added that considering the widely extended and rapidly extending subscription list enjoyed by the ELECTRICAL NEWS among users of electric and engineering appliances, the makers of such articles need not hesitate in deciding how they may most directly and cheaply reach these classes.

THE city council of Montreal are threatened with litigation over their telephone communication by the new Merchants' Telephone Company who are insisting upon the city council granting them the privilege to erect poles on the streets. The company maintain that according to their charter, they have the right to do this in any city in the province. They declare their intention should the city refuse their application to carry the matter into the courts. The difficulty the council find in granting this request is that the Bell Telephone Company refuse to continue the work of placing their wires underground according to their charter until the council pass a resolution permanently prohibiting the erection of poles in the city by other telephone companies. This step of the Bell Telephone Company is we think perfectly justifiable, for they have already expended nearly $40,000 in underground work, and it will cost yet a large sum before the work is completed. Why should they be put to this expense in order to make room for poles to be fixed in the street by another company who would, by this means, be able to enter into competition with wires laid at one seventh the cost of underground work. It appears strange that a company should be given a franchise to put up poles in the streets of any city in the Province without giving the municipal authorities power to prevent such work if they should deem it desirable to do so.

DURING the last year the development of electric railways in Canada has been exceedingly rapid. One new enterprise of this character has crowded so fast upon another that there have usually been from half a dozen to a dozen roads under construction at the same time. The efficiency and economy of the trolley system has been so clearly demonstrated that little difficulty is now experienced in securing the necessary capital for the construction and equipment of new roads where the conditions are such as to make it reasonably certain that sufficient business can be developed to pay a fair return upon the capital invested. In fact, judging from the number of new roads, and the reputation for sound judgment of many of the persons who are embarking their capital therein, electric railways have come to be regarded as being amongst the safest and most desirable business investments. Electric railroad development is said to be more rapid proportionately in Canada than in the United States, notwithstanding the speedy revolution which has taken place in this direction on the other side of the line. Nor is there at present any prospect that the rate of progress in this country will in the near future decrease. The fact is becoming apparent that in the case of suburban roads it will not be necessary to look to passenger traffic alone to provide the necessary returns, but that a profitable business may also be done in the carrying of light freight. This fact will doubtless lead to the extension of such roads into the rural districts and to their use by farmers instead of the familiar two-horse waggon, which in the present stage of perfection of country roads, is a slow and costly method of conveying produce to market.

THE Railway Committee of the Privy Council have amended their order passed in September last, under which the City and Suburban Electric Railway Company of Toronto Junction were held liable for the entire cost of protecting the crossings with the Grand Trunk Railway on the Davenport Road and the Canadian Pacific and Grand Trunk railways on St. Clair avenue. The committee now order the cost of maintenance to be apportioned as follows: The cost of protecting St. Clair avenue crossing is to be borne, one-half by the electric railway, one-quarter by Toronto Junction, two-thirds of the remainder by the G. T. R., and one-third by the C. P. R. The electric railway will bear one half of the expense of the Davenport road crossing, Toronto Junction and the G. T. R., one quarter each. The cost of protecting both crossings would be about $2,000 per year. This is not only a question affecting the company running the cars at the present time, but the public, as the franchise of an electric railway is made less valuable when the whole cost of maintaining such crossings is thus imposed upon street railway companies. It must also be remembered that the parties who maintain the crossings, will also be held liable for improvements, such as the building of bridges, &c., should the traffic on the road increase to such an extent as to make these necessary. While this question of crossing tracks has been agreeably settled in the north-west of the city with a new street railway company, it is surprising that a difficulty should have taken place between the G. T. R. and the Toronto Street Railway Company in reference to the crossings at the Don. This latter company is of long standing and its right of crossings, which has been exercised for years, has never been suspended. True, it has been held that street cars come under the Railway Acts when they are propelled by electricity, but surely the law never intended that when an old company by this means placed itself under these Acts, it should forfeit its prior existing rights to cross railways. Such legislation to our mind would be as unjust as to saddle the City and Suburban Railway Company with the entire cost of maintaining the crossings already referred to. The crossing no doubt needs better protecting, which could be done by the erection of gates similar to those described elsewhere, and the Street Railway Co should have no difficulty in arranging with the G. T. R. and the city regarding the terms upon which it should be carried out and maintained.

ENGINES FOR ELECTRIC LIGHTING.

IV.

One of the largest and at the same time most complete and most successful systems of power transmission is to be found in Paris, France. It was originally designed to supply compressed air for the regulation of clocks, and four years ago 8000 clocks were connected with the system. It is now the largest compressed air system in Europe.

The company has four central stations; three of these have each two thousand horse power, and the fourth has machinery for eight thousand horse power, and is laid out to contain machinery capable of supplying twenty-four thousand horse power.

The air is compressed by means of steam engines, and is distributed under a high pressure in mains and used to drive engines, instead of steam, and for other purposes. In some of the earlier appliances about 50% to 54% of the power developed at the station was utilized in the engines of the consumers. Later improvements have been effected so that 80% and over has actually been made use of.

In the new large station the steam engines used are triple expansion vertical engines using about 1¼ pounds of coal per horse power per hour.

The air is delivered at a pressure of 60 lbs. per square inch, and is in some cases made to pass through a heating arrangement before being used in the engine.

This system of using air for distributing motive power has many points in its favour, and will prove a strong competitor

with electricity. The pipes conveying the air are made in lengths of about 9 feet with flanges and joints made with India rubber. The loss from leakage is very slight. When power is required for lighting purposes an air driven engine may be used to run an electric dynamo and so produce electric light.

Another method of power distribution which has very much to commend it has been long in partial use. The distribution of gas as a fuel and its use in gas engines for the production of power will yet be much more extensively employed than it ever has been. There are no serious difficulties in its manufacture, storage, distribution and use. It can at once be applied for power, light or heat and can be carried long distances with very little loss, and used with safety even by unskillful persons.

Gas engines are now made of all sizes, from one horse power up to over two hundred horse power. The quantity of gas used in the first commercially successful gas engine was from 20 to 25 cubic feet of coal gas per horse power per hour, in engines of even small size, that is under 40 horse power. Reduced to a coal consumption, these engines have been run as low as one and one-tenth pound of coal per horse power per hour. Within the last few years improvements have been made, making the gas engine a much more perfect machine than it was, and it bids fair to be a formidable rival to the steam engine.

The use of gas as a means of distributing power has probably more to commend it than any of the schemes considered. By it engines may be driven and light and power distributed by electricity as so many are now doing by steam When the demand for more power comes, another engine can be at once started without any preliminary getting up of steam. When the demand ceases, the engine can be stopped without any loss from leaving boilers with steam up and fires burning.

The convenience of working the power at distributing stations is at once apparent, and as fuel gas can be made more cheaply than illuminating gas and can be used in the engines, the economy will be found by all who will try it.

Another advantage in such a system would be that many customers could be found who did not want either power or light, but would take the gas for cooking and heating purposes. In some places there would be a difficulty in getting such works started owing to the existence of illuminating gas companies having chartered rights as to the laying of pipes under the streets and such like privileges, but in other growing towns where there are no gas companies there would be less difficulty, and once the great advantages of the system were put into practical use the way would be opened up in large cities.

AUTOMATIC TELEPHONES.

It is as much an open question now as it ever was in the days of the immortal Shakespeare, whether it is not better to "bear the ills we have" than "fly to others that we know not of." It is perhaps ungallant to speak of the long suffering and usually patient "hello girl" as a cross to be borne with Christian resignation, but the stern and solemn fact remains, that if you ring your bell too much in her ear the "linked sweetness long drawn out" that is supposed to characterize the angelic switchmaiden of your lightning expressions is liable to be changed to something undeniably peppery.

A device more or less complicated, intended to do away with the "central" operator, is now being brought before the public, but why the expense of such a complicated conglomeration of apparatus should be gone to in order to deprive a few young ladies of a chance to earn their daily bread is totally beyond our comprehension. Our comprehension may be limited, but while the fact remains that the annual interest on the cost of a six or eight wire system, such as the new-fangled idea requires, would be more than enough to pay the wages of expert operators, we are compelled to cry *cui bono*, what is the good? Why displace the operators whose wages are a small fraction of the expense of a telephone system in order to introduce other complications and expenses.

"The ills we have," to wit, the extremely affable young ladies at "central," we are all more or less acquainted with; now let us look at one or two that at present we "know not of," but which the eloquent automatic projectors would like to run us up against. We all know how thoroughly reliable electric currents are when there is a speck of dust in the key contacts or a leakage of battery power to ground during wet weather. This last factor is so important in the adjustment of a magnet and variation, that a telegraph operator has sometimes to keep the adjusting screw of his relay continually in his hand while using the instrument. The "automatic" exchange instrument for each telephone, containing four or five magnets, is expected to look after itself (no operators need apply), to adjust itself, to keep itself clean, to automatically put on its own bib and tucker and to go to church Sundays—in fact to lead an exemplary life generally; no one is allowed to take a fatherly interest in the orphan because—is it not "automatic"? Now we will suppose a subscriber wants to call up the general hospital and has gone through the cabalistic performance on the keys required to make the necessary number, and we will stretch a point and further suppose he has done it correctly, and some wandering microbe of a fly, as we ex-speckt he might, has been fooling around one of the contact points and the machine has slipped a cog—only one cog, mind, in the possible 9999—instead of the general hospital he would be just as likely to get the jail. Imagine what a shock to Cholly's feelings if he tried to call up his sweetheart and got an undertaker, or the effect on the presiding maiden of the Y. W. C. G. if some besotted bibulist took her for a brewery and ordered a dozen of beer and one of old Tom gin and send it in a brace of shakes at that! There would be a delightful uncertainty as to what you were going to get about the business that would be particularly charming. It would be a soul-destroying invention, no doubt of that. If you wanted the Salvation Army for instance, and got the Mercer Reformatory, you would not, metaphorically speaking, take off your hat and apologize to the polite operator at Central for not speaking plainer. Oh no! The restraining influence of that young lady's presence as it were would be absent, and you would illuminate the dark depths of the automatic's transmitter with a blue streak of indignation that would make the six wires sizzle to try and carry it all away at once.

Any system that depends on a battery current to work its mechanism at a distance, must in the nature of things be uncertain. The failure of the writing telegraph that was shown some years ago was entirely due to this cause. The apparatus would work perfectly with a definite resistance and uniform battery, but was inoperative when exposed to vicissitudes of weather and distance. If, as is proposed, a common battery main is used with branches to each subscriber, a cross on the line, liable to happen at any time, would paralyze the whole exchange.

The switch board would have the same number of connections as the ordinary telephone switchboard, with the addition of a complicated piece of mechanism in place of the plain annunciator drop of the ordinary system. Its adoption, instead of saving in the cost of labor, would simply substitute expensive mechanics for comparatively inexpensive operators.

The claim that a small country town or village could use this system instead of the ordinary one does not appear to have good foundation. If automatic instruments were installed it is idle to say that they would look after themselves. They would have to be maintained. It would simply mean the substitution of an expert to keep them in order, instead of the cheaper boy or girl whose only qualification needed would be the ability to ring a telephone bell.

The immense cost of the system in a large city would far overbalance the amount of the wages of a few girls, while the uncertainty of results would be a serious, if not a prohibitive drawback. We have fresh in our mind the words of caution given on the subject of electric investments by the president of the Canadian Electrical Association at its last convention, but do not think that investors, though they may not know very much about the matter technically, will place much faith in a telephone company who would offer to equip every town and village in the county and build trunk lines from New Brunswick to British Columbia on a capital of $250,000.

Work on the $3,000,000 contract for laying the tracks of the Montreal Street Railway was commenced on the 24th ult.

The Montreal Street Railway Company have discovered an extensive system of stealing amongst their conductors, by resorting to the old trick of putting a tube in the boxes.

A proposition has been made to count the hours for telegraphic purposes from a fixed meridian so as to obviate the anomaly of receiving news of events happening a day after it is received here.

THE COST OF STEAM POWER PRODUCED WITH ENGINES OF DIFFERENT TYPES UNDER PRACTICAL CONDITIONS, WITH SUPPLEMENT RELATING TO WATER POWER.*

By Charles E. Emery, Ph. D.

(1) The author first refers to his previous paper on "The cost of Steam Power," published in the Transactions of the American Society of Civil Engineers in 1883, stating that he had been urged to modify it to suit more recent conditions, but that he believes it still substantially correct for the particular purposes for which it was originally designed, to wit: to show the capitalized or present value of steam power in different units maintained forever. The prices of engines have varied since the paper was prepared, but this fact has proportionally little effect on the results, and in any case corrections must be made for the difference in prices of fuel.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
DESIGNATION.	TYPE OF ENGINE. NAME.	INDICATED HORSE POWER	STEAM PRESSURE BY GAUGE	FEED WATER PER INDICATED HORSE POWER PER HOUR. Probable Limits.	FEED WATER PER INDICATED HORSE POWER PER HOUR. Assumed for Comparison	CUMMERCIAL HORSE POWER	APPROXIMATE COST PER NET HORSE POWER OF ENGINES ERECTED AND CONNECTED READY FOR OPERATION	APPROXIMATE COST PER NET HORSE POWER OF Boilers erected and connected ready for steam	APPROXIMATE COST PER NET HORSE POWER OF BUILDINGS AND CHIMNEY	APPROXIMATE COST PER NET HORSE POWER OF TOTAL OF THE THREE PREVIOUS COLUMNS.	APPROXIMATE COST PER NET HORSE POWER OF Total with all over heads for superintendence and interest on loss of interest during construction added	WATER EVAPORATED PER POUND OF COAL.	COAL PER INDICATED HORSE POWER PER HOUR.	TONS OF COAL (OF 2240 LBS.) PER DAY WITH AVERAGE COAL FOR ONE HOUR ADDED FOR STARTING AND STOPPING FIRES. For ten hours per day.	TONS OF COAL (OF 2240 LBS.) PER DAY WITH AVERAGE COAL FOR ONE HOUR ADDED FOR STARTING AND STOPPING FIRES. For twenty-four hours per day.
		I. H. P.	Lbs. per sq. in.	Lbs.	Lbs.	C. H. P.	Dols.	Dols.	Dols.	Dols.	Dols.	Lbs.	Lbs.	Tons.	Tons.
A	Simple High Speed, Non-Condensing	540	100 to 120	35 to 26	33	590	17 50	26.12	15.18	58 90	63 91	8.5	3.882	10.330	19.315
B	" Low " " "	556	100 to 120	32 to 24	29	537	25.00	23 63	14 92	62.85	68.19	8.5	3.412	9.316	17.315
C	Compound High " " "	542	100 to 120	30 to 22	26	570	21 00	20 62	13.13	54.81	59.47	8.5	3.059	8.142	15.344
D	Special Triple Compound High Speed Non Condensing	542	150 to 170	27 to 21	24	434	26 00	21.70	12.53	60.25	65.37	8.5	2.824	7.316	14.349
E	Simple High Speed Condensing	540	100 to 120	25 to 19	22	397	21 00	17 47	11 95	50.42	54.71	8.5	2.580	6.858	13.230
F	" Low " "	556	100 to 120	24 to 18	20	371	27.00	16.31	11.53	54.84	59.51	8.5	2.353	6.435	12.365
G	Compound High " "	542	150 to 170	24 to 18	20	361	24.50	15 82	11.36	51 68	56.14	8.5	2.353	6.963	11.930
H	" Low " "	556	150 to 170	20 to 15	18	334	30 00	14 70	10.92	55 62	60.35	8.5	2.118	5.783	11.040
I	Special Triple Compound High Speed Condensing	542	150 to 170	23 to 16	17	307	25.00	15 33	10.29	54.84	59.50	8.5	2.000	5.523	10.163
J	Triple Compound Low Speed Condensing	556	150 to 170	22 to 15	16	297	37 50	14.85	10.31	62.67	68.00	8.5	1.882	5.139	9.810
K	do do	556	180 to 170	17 to 12½	15	278	45.00	13.90	8.35	67.25	72.97	8.5	1.765	4.819	9.200
L	Do For Probable Maximum Results	556	180 to 170	16 to 12½	14	256	45.00	12.96	8.15	66.10	71.72	9.5	1.470	4.015	7.683

Table 1, Showing Cost of Steam Power.

(2) The author has therefore decided in the present paper to compare the cost of developing a given amount of power with several of the different kinds of engines now in general use. A unit of 500 net horse-power has been selected, which it is assumed is delivered at a speed of 250 to 350 revolutions per minute, corresponding to the jack shaft speed of slow engines and the actual speed of high speed engines.

(3) While the writer attempts to examine all the principal causes which affect the cost of steam power, the prominent feature of the discussion is the substantial equalization of the cost of the power developed with engines of different types and different degrees of economy when expenses independent of the coal consumed are considered. Attention is called to the fact that such expenses are fairly constant and will in some cases equal the cost of coal. The result is, that if one engine saves a certain large percentage of fuel compared with another, such percentage is reduced one-half when applied to the double quantity, and in many cases the lower percentage will be balanced or more than balanced by the difference in interest on the cost of the different engines.

a	q	r	s	t	u	v	w	x	y	z	A	B	C	D	E	F
	COST OF COAL PER HORSE POWER PER YEAR. ON BASIS OF 308 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2000 POUNDS DELIVERED AS FOLLOWS:				ON BASIS OF 365 DAYS OF 20 HOURS EACH AND COST OF COAL PER TON OF 2000 POUNDS DELIVERED AS FOLLOWS:				COST PER NET HORSE POWER PER YEAR OF SUPPLIES AND AVERAGE REPAIRS.		COST PER NET HORSE POWER PER YEAR OF WAGES.		COST OF INSURANCE, 1 PER CENT., OF TAXES 1½ PER CENT., OF RENEWALS 3½ PER CENT. TOTAL 5 PER CENT. OF COSTS IN COL. A.	INTEREST OR DIVIDENDS 8½ PER CENT. OF COSTS IN COL. Z	TOTAL COST PER HORSE POWER PER YEAR OF ALL OPERATING, CURRENT AND INTEREST EXPENDITURES EXCEPT COAL	
									308 days of 10 hours each.	365 days of 20 hours each.	308 days of 10 hours each.	365 days of 20 hours each.			308 days of 10 hours each.	365 days of 20 hours each.
	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.
A	12.73	19 09	25.46	31.82	28 80	43.20	57 60	72.00	2.96	7.01	4.78	11.34	2.95	6.30	27 08	37.29
B	11.43	17.22	22.96	28.69	25 97	38 95	51.93	64 92	2.53	5.99	4.49	10.65	3.14	6.28	26.98	36.60
C	10.83	15.05	20.06	25.08	23.69	34.04	45 39	56.74	2.96	7 02	4.16	9.87	2.74	5.95	25.81	35.57
D	9.16	13.89	18.52	23.15	20.95	31.42	41.90	52.37	2.96	7 01	3 99	9.45	3.01	6.54	26.50	36.01
E	8.49	12.73	16.97	21 22	19.30	28.80	38.40	48.00	2.96	7.01	3.51	9 02	2.53	5.47	24.78	34.02
F	7 91	11.87	15.83	19.79	17 91	26.86	35.81	44.77	2.53	5 99	3.68	8.71	2.74	5.95	24.00	33.30
G	7.72	11.43	15.43	19.29	17.46	26.18	34 91	43.64	2.96	7.01	3.63	8.60	2.59	5.61	24.79	33.81
H	7.13	10.65	14.25	17.81	16.13	24.18	32.24	40.30	2.53	5.99	3.49	8.28	2.78	6.04	24.84	33.09
I	6.56	9.84	13.12	16.40	14.84	22 25	29 68	37.10	2.96	7.01	3.36	7.97	2.74	5.95	25.01	33.67
J	6.33	9.50	12.66	15.83	14.32	21.48	28.65	35.81	2.53	5.99	3.31	7.85	3.13	6.80	25.77	33.77
K	5.94	8 91	11.87	14.84	13.43	20.15	26.86	33.58	2.53	5.99	3.20	7 63	3.36	7.30	26.41	32.98
L	4.98	7.44	9.91	12.40	11.22	16.83	22.43	28.04	2.53	5.99	2.74	6.53	3.51	7.17	26.75	35.54

Table 1 (Continued), Showing Cost of Steam Power.

(10) The writer submits Table 1, showing in detail the cost of one-horse power per year developed in engines of different kinds when operated for 10 hours per day for 308 days in the year, and for 20 hours per day for every day in the year, with columns showing the results in each case for coal costing $2.00, $3.00, $4.00 and $5.00 per ton. The results are at first presented on the basis that the power required is comparatively steady so that

*An abstract of a paper read before the American Institute of Electrical Engineers, March 21, 1893, and printed in the N. Y. *Electrical Engineer*. For convenience of reference to the original paper, the paragraphs in the abstract have been numbered to correspond with the original paper.

no surplus machinery is required. A second presentation shows the results for electric light and other plants in case 50 per cent. surplus machinery be provided to supply the maximum power during certain portions of the day and the power for the remainder of the day be sufficiently low to maintain the average.

(11) The different lines of the table refer to engines of the types stated in column *b*. The author states that the last three lines are devoted to low speed condensing triple compound engines. Of these, line *J* shows the probable results with machinery designed to secure economy in construction rather than the highest economy of fuel. Line *K* refers to a low speed triple compound engine more expensively constructed, for which the economy is assumed lower than in the other case and for which the results are believed to be the best that can be secured under ordinary average practice even with the best machinery. There has, however, for comparison, been added another line, *L*, assumed to be operated at still lower economy by the use of boilers of unusual economy and careful attention to the details of operation, for which purpose $1.00 per day is added to the labor account. The results shown in this line are believed to be the maximum which can be obtained under the conditions of unusually good practice with the best care available.

The author then proceeds to describe the several columns of large numbers of small machines of any kind under conditions securing a substantially uniform load will necessarily give nearer the minimum results shown in column *e*, but engines generating electric current for electric railways or subject to variable loads of any kind will rarely show economies as low as has been assumed for comparison in column *f*.

(16) Column *g* shows the commercial horse-power of boilers on the now accepted basis of 30 pounds of feed water per horse-power. It will be noticed that the high speed non-condensing engines in line *A* required 596 boiler horse-power to produce 500 net horse-power, and that the power of the boilers continually diminishes the reduction in feed water per horse-power, so that for the case last named, line *L*, only 259 boiler or commercial horse-power is required.

(17) The cost of the boilers is shown in column *i*, the prices including not only the original cost of boilers proper, but the erection and connection of the same. This section also discusses at some length the desirability of duplicate values and connections to insure the continuous operation of boilers where stoppages cannot be permitted.

(18) The prices on above basis have been fixed at $22 per commercial horse-power for the lower steam pressures and $25 for the higher pressures. These prices are believed sufficient to

$C_1 = .040\,S + .06\,A + .075\,E$

a	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	a
	TOTAL COST PER NET HORSE POWER PER YEAR ON BASIS OF								TOTAL COST PER NET HORSE POWER PER YEAR FOR ELECTRIC R. R. AND OTHER VARIABLE WORK REQUIRING 50 PER CENT. EXTRA PLANT TO OBTAIN ON THE AVERAGE 500 H. P. INSURANCE INCREASED TO 1½ PER CENT., ENGINE RENEWALS TO 4 PER CENT AND BOILER RENEWALS TO 5 PER CENT								
	300 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2000 LBS. AS FOLLOWS:				365 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2000 LBS. AS FOLLOWS:				FOR 300 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2000 LBS. AS FOLLOWS:				FOR 365 DAYS OF 10 HOURS EACH AND COST OF COAL PER TON OF 2000 LBS. AS FOLLOWS:				
	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	$2.00	$3.00	$4.00	$5.00	
	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	Dols.	
A	29.81	36.17	42.54	48.90	36.49	70.89	85.29	99.69	33.45	41.82	48.19	54.55	62.14	76.54	90.94	105.34	A
B	28.46	34.90	39.94	45.87	32.57	65.51	78.53	91.38	34.55	40.28	46.02	51.75	58.65	71.64	84.62	97.60	B
C	25.84	30.86	35.87	40.89	43.30	59.01	70.96	82.31	31.10	36.19	41.13	46.15	53.52	64.87	76.22	87.57	C
D	25.76	30.59	34.03	39.65	42.96	57.43	67.91	78.38	31.03	36.25	40.91	45.54	53.85	63.33	73.80	84.27	D
E	23.05	27.49	31.73	35.98	43.22	58.82	64.42	70.02	28.03	32.32	36.55	40.81	48.05	57.65	67.25	76.85	E
F	22.89	26.77	30.73	34.69	41.30	56.25	59.20	68.16	28.13	32.07	36.03	39.99	46.60	55.55	64.50	73.46	F
G	22.51	25.36	28.22	31.08	41.27	48.99	58.72	67.45	27.48	31.33	35.19	39.05	46.24	54.96	63.69	72.42	G
H	21.07	23.53	25.99	28.45	39.21	47.27	55.33	63.39	26.36	30.02	34.48	38.04	44.60	53.66	60.72	68.78	H
I	21.57	24.85	28.13	31.41	38.51	45.03	53.53	60.77	26.98	30.80	33.48	36.76	43.36	51.28	58.70	66.12	I
J	18.10	25.27	28.43	31.60	38.09	43.95	52.42	59.58	28.77	31.44	34.60	37.77	44.26	51.42	58.59	65.75	J
K	22.33	23.32	28.28	31.25	37.71	44.43	51.14	57.86	29.10	31.07	35.03	38.00	44.46	51.18	57.89	64.61	K
L	21.71	24.19	26.67	29.15	36.56	40.17	47.77	53.38	28.33	30.81	33.29	35.77	43.18	48.79	54.39	60.00	L

TABLE 1, (CONTINUED), SHOWING COST OF STEAM POWER.

the table. Most of these will be understood by reading the headings. We note, however the following:

(13) In column *c*, the indicated horse-power required to produce 500 net horse-power has been fixed at 542 for the high speed engines and 556 for the low speed engines, to include the friction of transmission to the jack shaft.

(15) Columns *e* and *f* relate to the feed water per indicated horse-power per hour, column *e* showing the portable limits within which the feed water required will vary for engines of the types stated, when constructed by different manufacturers or operated under different conditions. The lower limit is believed to have been fixed in each case at the minimum result which has been obtained by reliable experiments with the class of engines referred to; these figures are therefore too low for average practice. The large figures in column *e* represent results which in the opinion of the writer may be obtained under less favorable but practical circumstances, and of course still larger costs would result from the use of apparatus imperfectly designed or improperly operated. Column *f* shows the feed water per indicated horse-power per hour assumed for comparison. The figures in this column are not intended to be averages of those given in column *e*, but those which can be safely depended upon under conditions of practice, with the load varying between considerable limits, thereby affecting somewhat the economy. It should be stated that the desire to have these figures decrease progressively where possible has somewhat influenced the values selected as well as the above considerations. Engines operating cotton mills or provide sectional boilers with settings and all attachments, and the writer expresses the belief that this class of boilers should be estimated for, even at somewhat increased first cost, from considerations of safety and reduction in repairs. The influence on the results due to difference in the prices of boilers is discussed later in connection with Table 2, which is not here reproduced.

(20) Column *h* shows the cost of engines erected and connected ready for operation. The writer speaks of the difficulty of obtaining these prices. Circulars were sent to different engine manufacturers and all kindly responded but many did not make engines of 500 h. p. or of all the types; some gave very low prices which might not be sufficient for close specifications, others added various percentages. The cost of some steam plants complete were, however, accessible. Mr. Pearson, of the West End Railroad in Boston, gave prices checking well with the prices given for the triple compound engines, and the prices of six complete plants of various sizes, using simple engines, were obtained from advance pages of a work in course of preparation by Messrs. T. C. Martin and W. H. Schlessinger, the average of which also checked the prices stated in the table, being a little lower on account of the type of boilers employed.

(23) Column *l* shows the amount in column *k* augmented 2½ per cent. for inspection and 6 per cent. for loss of interest during construction, incidental salaries, etc. There percentages are independent of architects commissions and are intended to cover numerous incidental expenses due to starting a plant. The per-

centage will generally be insufficient rather than the contrary, except in cases where a plant is simply increased after the organization is established.

(24) An inspection of column *l* shows an unexpectedly small difference in the total cost of steam machinery of different types when everything is considered. It is a curious fact that steam machinery of fairly good economy shows the lowest first cost, the cost of the simpler machinery being higher on account of additional boilers, and that of the more economical machinery being higher on account of the higher cost of engines, etc.

(To be Continued.)

ENGINEERING AND ELECTRIC PLANT AT THE PARLIAMENT BUILDINGS, TORONTO.

THE new home of legislation for Ontario is about completed, and we give some particulars of the engineering plant which will be found interesting.

The boiler room is situated in the north basement. It contains six horizontal multi-tubular boilers built by John Abell, of Toronto. They are made of "Otis" homogeneous steel, 60,000 pounds tensile strength. Each has a diameter of 5½ feet and is 16 feet long; the shell is ⅜, the head ½, and the dome (30×30) ⅜ of an inch thick. The boilers have each 98 three-inch tubes running the whole length, made of charcoal iron, and are furnished with McClave's patent grate. They are provided with cast iron flush fronts of a neat design, double folding doors, and all the exposed fittings are nickel plated, which gives a good finish to the work. The boilers have been tested by hydraulic pressure to 150 pounds per square inch.

The engine is a self-contained automatic cut-off of 50 horse power, and was also made by John Abell, of Toronto. It is said to be the first of its kind built. There is also in the boiler room one of Curtis' hot water purifiers connected with the high pressure steam lines. The entire buildings are warmed with low pressure steam, and provision has been made for utilizing the exhaust steam by passing it through the purifier and heater.

The heating is carried out by direct and indirect radiators, and over 8 miles of wrought iron piping is employed in this work—5616 feet of main pipes being from 3 to 12 inches in diameter, and 37,208 feet of branch pipes varying in size according to radiators supplied. In the direct system there is 26,173 square feet of heating surface in the radiators, and the indirect supplies 5,060 square feet.

The indirect radiation to the principal rooms is controlled by a clever electric device; attached to the thermometer in the room to be heated is a small thermostat which is so sensitively arranged that whenever the atmosphere changes the reading of the thermometer from 68°F., the instrument, by its connections with the switch dampers, is able to instantly throw the cold air over, under or through the radiators in the same proportion.

Mechanical ventilation is resorted to in the buildings by means of two large extracting flues (8×7 each), which are connected by large galvanized iron ducts or pipes to every room in the building. The flues are each provided with an 80-inch Blackman's exhaust fan, and the main duct has a fresh air propellor 48 inches in diameter. In the main air shaft there is a cheese cloth bag screen 25 feet long for cleansing purposes, which is so arranged that when one bag becomes full a duplicate can be easily substituted.

The electric lighting is entirely on the "three wire" system and the current is supplied by the Incandescent Light Co. to the east and west ends of the building, and is conducted along the ceiling of the basement by means of a double set of "0000" mains. From these there are 18 large distributing risers, and each one supplies a section of the lighting on each flat. The total number of lights in the building, which is arranged for gas as well as electric light, is 2600, of which 2000 are 16 c. p., and the remainder 32 c. p. and upwards. About 8 miles of wire is used in order to supply these lights.

Special care has been taken to provide means by which the distributing wires, while concealed, can yet be easily got at in case of necessity. The wires are carried along the wall covered by a moulding about 5 inches deep. This is fixed round the entire room whether there are wires to hide or not, so that the work appears as part of the decoration. If the wires need attention, it is only necessary to remove a length of this moulding, and the work can be done without further trouble or any damage. It is a very simple but useful contrivance, and is said to be adopted for the first time in these buildings.

The electric light fittings throughout the several departments are worthy of notice. They are in bronze, old gold, brass and black iron. In the Legislative Chamber there are four electroliers well worth inspecting. They were made from special designs by the Central Gas and Electric Fixture Co., of Brooklyn, and cost about $1500 apiece. The metal used is polished bronze, which blends well with the other decorative work of the Chamber. Each electrolier has 24 lights, with the same number of gas burners, which are most artistically arranged. It is doubtful whether there is a finer specimen of this class of work in America, either in design or workmanship. Besides these chandeliers there are 22 brackets, each giving 5 lights, and there also is an arch of lights over the Speaker's chair.

Before leaving the electrical appliances it is necessary to mention the four electric elevators erected in the building by Messrs. Otis Bros. & Co., of New York. In these elevators the power is derived from the Eichemeyer motor, the use of which this firm controls for elevator purposes. To give motion to the elevator machinery the motor shaft is connected by a double worm gear to the winding drum, thus giving perfect steadiness of operation. The power is controlled by means of a starting wheel in the car, and is communicated to the motor in such a way that the car stops and starts with perfect ease. This is effected by means of a rack and firside arrangement, which works the brush in the face of the resistance box, thus turning on more or less current as may be required. In addition to the usual Otis safeties on the car these machines are provided with an automatic brake and with safety stops at the top and bottom of the cars' travel, which completely control their operation. The cars are overbalanced by counterweights running in wood guides, so that, as a rule, the power is simply needed to give a first impetus to the cars, after which the use of power is reduced to a minimum. Should the cable become slack, the current is immediately cut off by an automatic slack cable stop, and in the motor room and cars the state of the switch is indicated by electric indicator lights.

The whole of the engineering plant, which is one of the most extensive in Canada, appears to have been constructed and installed in a most satisfactory manner. It is under the control of Mr. A. M. Wickens, whose engineering abilities are well known. He was until recently engineer to the *Globe* Printing Co., and is a past president of the Executive of the C. A. S. E.

TRADE NOTES.

Mr. C. W. Henderson, electrical contractor, Montreal, is moving into larger premises on Bleury street.

Messrs. J. M. Harriston and H. A. Seyler, both practical electricians lately in the employ of the Royal Electric Co., are about to start business on their own account at 781 Craig street, Montreal, under the name of the Montreal Electrical Supply Co.

Those of our readers who were at the exhibitions held at Toronto and Montreal last year, will no doubt remember seeing an automatic high speed engine exhibited by the Robb Engineering Co. of Amherst, N. S. At that time these engines were in use only in the maritime provinces, but several are now placed and others contracted for at Montreal and other points west. This engine is one of the latest put on the market, and is up to date in every respect, the governor and valve being essentially the same as the "Straight Line," and are used by arrangement with the Straight Line Engine Co. The Robb Engineering Co. also manufacture an improved boiler called the Monarch Economic, a large number of which are in use in electric light stations and factories in the maritime provinces, and three of which, we understand, are soon to be placed in an electric light station at Windsor, Ont., along with a large Robb-Armstrong engine. Users of the boiler find it very much more economical than the ordinary brick set boiler, and it has all the advantages of light portable forms, being ready to put in position when it leaves the works.

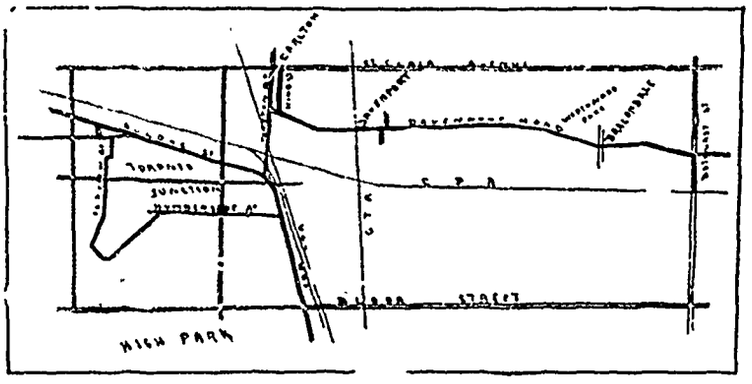
Mr. T. W. Ness, of Montreal, has sent quite a large exhibit of the telephones and switchboard apparatus which he manufactures to the World's Fair at Chicago. Before sending it a photograph was taken, by which we notice that a very interesting display will be made. Besides the ordinary Standard Bell Telephones, which are used for private lines and local exchanges, there is a switchboard for use in central offices fitted up complete ready for work. This is a sample of the large number of switchboards which this firm has recently been building and supplying throughout Canada. Quite a large variety of warehouse telephones was also shown. This system, although largely used throughout this country, is comparatively new in the United States. Briefly described it is a system by which each telephone is its own central exchange. By turning a switch to the desired number any department of a factory may be called up from the office or from one department to another as desired. There were also a number of desk telephones on fixed and also moveable arms for special use in banks and public or private offices. Blake and Carbon transmitters, receivers and annunciators completed the list of articles sent. Owing to the patents on these articles expiring at the present time, it is expected that this exhibit will cause more than ordinary interest to those attending the World's Fair.

ELECTRIC RAILWAY DEPARTMENT.

CITY AND SUBURBAN ELECTRIC RAILWAY.

In our last issue we gave some particulars relating to a proposed electric street railway to be built and operated in the eastern suburbs of Toronto. Some notes concerning the electric railway now running along the north-west limits of the city may also prove interesting.

The railway was built by the Canadian Edison Electric Co. and is the property of the City & Suburban Electric Railway Co. This company, with which is incorporated the Davenport Railway Co., has a capital of $200,000. Their offices are situated at the corner of Dundas and Keele streets, Toronto Junction.



Mr. H. W. Darling, of New York, is the President; Mr. R. H. Fraser, late superintendent of Nova Scotia Central Railway, is the manager and secretary; Mr. R. M. McNaugh, electrician, and Mr. H. Mowatt, engineer. We show a diagram of the present route of the railway which is about six miles long and has a single track with loops at convenient stages to allow cars to pass each other. The line passes under the C. P. R. tracks on Keele street by means of a substantial subway built in stone. It also crosses the G. T. R. on St. Clair avenue and again on Davenport Road. At these two points signal towers have been built with gates and proper diamonds to the tracks. This work was executed by Messrs. N. S. Piper & Son, of 314 Front street, Toronto, and is the first of its kind. We refer to this at more length in another place, giving an illustration reproduced from a photograph, of one of the junctions. Four and one-half miles of the line are laid with 56 lbs. T rails upon sleepers, and the remainder is shortly to be relaid with similar material. Along the streets in Toronto Junction the rails are 69 lbs. T rails laid on girders, and have concrete foundations where the streets are paved.

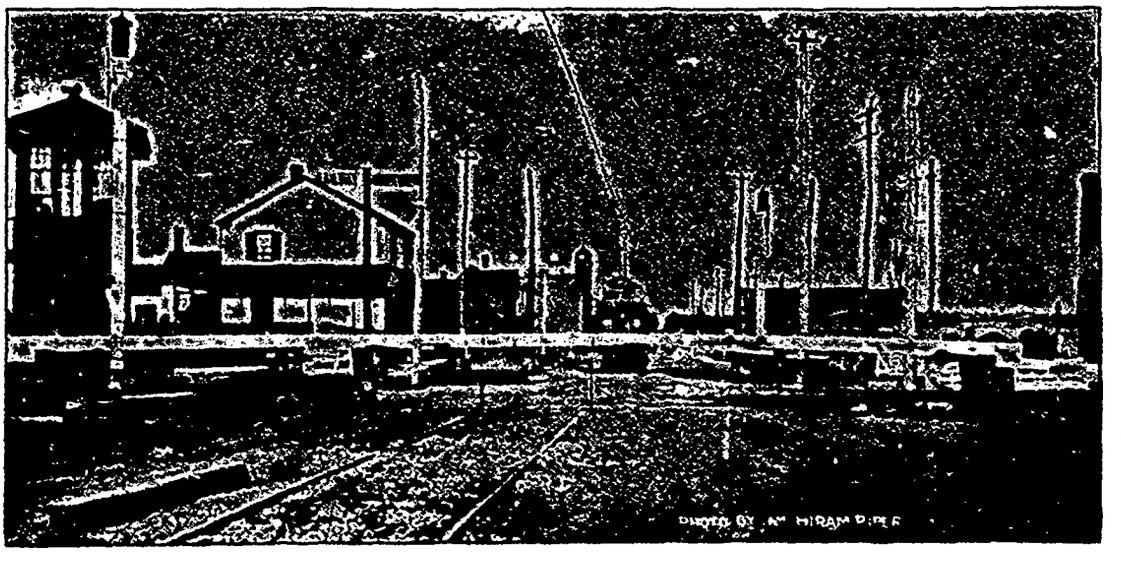
The power house, a view of which can be seen in the cut showing the crossings already referred to, is situated on the south side of St. Clair avenue, and has a car house adjoining capable of holding 12 cars. The building is in red brick, and about 150 feet long and 50 feet wide. The engine room is fitted up with 125 h.p. Leonard-Ball engine, which is coupled with a No. 33 Edison generator of 100 kilowatts or h.p. The cars, of which there are five, were built by Patterson & Corbin, of St. Catharines. They are 16 feet in length, and the interior which is capable of seating 30 persons, is fitted up exceptionally comfortable. The platform at each end is covered in by glass partitions, which not only shelter the motorman and conductor during rough weather, but greatly assist in preventing the cold from finding its way into the interior of the cars.

One car is worked by a Westinghouse motor of 50 h.p.; three have Edison motors of 20 h.p. each, and the remaining one has a similar motor of 40 h.p. Three of these are now running on the road, giving a 10 minute service.

The railway will be found a great convenience to those having to travel between the city and Toronto Junction, as the service, combined with that of the Toronto Street Railway, is far better than the railway facilities on account of the cars running more frequently. This benefit will be still better appreciated when the latter company runs an electric car service on Bathurst street.

The City and Suburban Railway Co. also provides improved means of transportation from the western to the northern suburbs of Toronto, and as the Toronto and Richmond Hill Railway, which is shortly to be built, will terminate at the same point on Bathurst street, further improvement will be obtained in this direction.

The company have made arrangements to extend their line down the west side of High Park to Swansea, meeting the Toronto and Mimico Railway on the Lake Shore Road. The track is now being laid, and it is hoped to have the cars running on this extension during this summer. As the new line passes through some of the well known Humber scenery, the cars will be much appreciated during the excursion season. It is proposed at an early date to extend the company's lines to Lambton and Weston. When these extensions are carried out, this portion of Toronto suburbs will be well provided with means of local transportation.



PROTECTION OF RAILWAY CROSSINGS.

The introduction of electricity to street cars as a motive power, has made it necessary to introduce where the tracks cross railway lines some complete system of signalling to prevent accidents, and a perfect and ingenious set of street gates with automatic signals have been invented for this purpose. The City and Suburban Electric Railway, of Toronto Junction, have had

gates of this description erected where they cross the C. P. R. tracks on St. Clair Avenue, and also where they cross the G. T. R. on Davenport Road. We give an illustration of the former gates which are operated by a signalman in the tower, by means of a crank attached to a gear stand, the one movement working the four street gate arms, four side-walk arms and semaphore signals, as follows: when the gates are open for traffic on the street the semaphore target is at right angles to mast, showing during day a "danger" signal, and at night a bright red light. The action of lowering the gates pulls the target to "safety," this being a perpendicular position, and at the same time changes the red light to white or green in accordance with rules governing colors in semaphores on the railway which crosses.

The appliance is so arranged that the gates have to be lowered to an angle of 35° before the target starts to move, and when gates reach the level, the signal is completely changed from "danger" to "safety." The same applies when gates are being raised after a train has passed, the signal gradually changing and showing complete "danger" signal when gates are at an angle of 35°. The semaphore is a positive signal in this way. The change of light is effected by an inside case holding the different colored lens, which slides on a frame, the two ruby lens coming opposite the plate glass disc in the outside case when the target is at right angles or "danger." When target is pulled perpendicular, or "safety," a corresponding movement takes place in the case, which now shows white or green light, as the case may be, where it before showed red, so that but one color at a time can be seen by the engineer on train about to cross. The gates are also equipped with red lamps, which swing between two shields which shut off the light from the trainmen and show bright red light in center of street when gate arms are down. In day-light, the red light is replaced by a bright red target, which is a great improvement on a red flag, for unlike a flag, the target does not require a wind to make it fly, and on the score of durability there is no comparison. Another advantage is that a man who has been unfortunate enough to have an arm or leg taken off on the railway is capable of attending the signal, as there is no ladder to climb, the lamp being elevated to its position from the ground by means of a chain, and the combined gates and signal easily worked with one hand from the tower. Messrs. Noah L. Piper & Son, Toronto, are the inventors and patentees of this very useful appliance. A large number of prominent railway and Government officials have inspected the gates as erected, and expressed their entire appreciation of the method adopted as a preventive of accidents. The system is well worth the attention of all companies situated so as to require the use of protective devices.

NIAGARA FALLS ELECTRIC RAILWAY.

RAPID progress is being made with the building of this line, and every effort is being used to have the railway open on the 24th of May next. When completed this will be the only road operating from its own water power, and the first time any part of the hidden power stored in the waters of Niagara Falls will have been put to any practical use.

The construction of the wheel pit and the driving of the tunnel to the river bank under the Falls, in order to provide for the discharge of the water passing through the water wheels, was no easy matter, and the engineer, Mr. R. W. Leonard, of Brantford, Ont., is to be complimented on the way the work has been carried out. The wheel pits are 80 feet deep, and contain two turbines or horizontal wheels of 1,000 h. p. each, which were made by William Kennedy & Sons, of Owen Sound, Ont. These wheels have immense iron cases, 10 feet 6 inches in diameter, set on iron girders, which are fixed to solid stone work.

The inlet canal, situated at the foot of Cedar Island, is 250 feet long, 14 deep and 18 wide. The water is conducted along this canal to a large basin and then through large iron penstocks, 7 feet 6 inches in diameter, to the water wheels. The outlet tunnel already referred to is 600 feet long, 8 by 10 feet in size and discharges near Table rock.

The electric power house is to be a handsome structure 100×62 feet, built in limestone, and will be situated opposite Cedar Island. Mr. Jas. Balfour, of Hamilton, is the architect, and Mr. J. G. Pocock, of the same city, the contractor. The interior of the building will consist of one large room in which will be the main shafting and three dynamos of 250 h. p. each, which are to be built by the Canadian General Electric Company.

At Queenston the railway is to be provided with another power house, near the river, in order to drive the cars up the heavy grade of the mountain, which is a mile and a half long and has a fall of 250 feet in a mile. The building will contain a boiler room 35×30 feet and an engine room 55×70 feet. The plant will consist of two engines of 150 h. p. each. The two dynamos to be used will have a capacity of 200 kilowatts.

There is no doubt the line will be greatly patronized by the excursionists who visit this locality and it is hoped that the wishes of Mr. Grant, the general manager of the company, will be realized by the line being in operation by the Queen's birthday.

MOONLIGHT SCHEDULE FOR MAY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 7.30	P. M. 9.00	1.30
2.....	" 7.30	" 10.00	2.30
3.....	" 7.30	" 10.50	3.20
4.....	" 7 30	" 11 50	4.20
5.....	" 7.30	A. M. 12.40	5.10
6.....	" 7.30	" 1.20	5.50
7.....	" 7.30	" 2.10	6.40
8	" 7.30	" 2.40	7.10
9.....	" 7.30	" 3.10	7.40
10.....	" 7.30	" 3.30	8.00
11.....	" 7.30	" 3.50	8.20
12.....	" 7.40	" 3.50	8.10
13.....	" 7.40	" 3.50	8 10
14.....	" 7.40	" 3.40	8.00
15.....	" 7.40	" 3.40	8.00
16.....	" 7.40	" 3.40	8.00
17.....	" 8.40	" 3.40	7.00
18.....	" 9.50	" 3.40	5.50
19.....	" 10.50	" 3.40	4.50
20	" 11.50	.....	3.50
21.....	.....	" 3.40	
22.....	A. M. 12.10	" 3.40	3.30
23.....	" 12.30	" 3.40	3.10
24.....	" 12.50	" 3.40	2.50
25	" 1.10	" 3.40	2.30
26.....	" 1.30	" 3.40	2.10
27.....	" 1.50	" 3.40	1.50
28.....	No light.	No light.	....
29.....	No light.	No light.	....
30.....	No light.	No light.	....
31.....	P. M. 7.50	P. M. 9.50	2.00
		Total,	140.20

PERSONAL.

Mr John Little, of Hamilton has been appointed manager of the Windsor electric railway.

Mr. Albert E. Edkins, the president of the Executive Board of Stationary Engineers, has returned from a visit to the Lower Provinces.

After a successful career, President Higgins, the originator and manager of the National Electric Tramway and Light Company, of Victoria, B. C., has resigned.

We regret to announce the death of Mr. A. Muir, manager of the Bell Telephone Company's branch at Lindsay. The deceased was a nephew of Judge Muir and was much respected.

Mr. John W. McRae, president of the Electric Street Railway at Ottawa, is likely to be the successor to Mr. C. H. Mackintosh should that gentleman be appointed Lieutenant-Governor of the North-west Territories in May next.

We are pleased to record the recovery of Mr. W. E. Davis, the electrical engineer to the Toronto Street Railway, from his severe illness of typhoid fever. He has gone to his home at Fall River, Mass., to recuperate his health.

Mr. George W. Inglis, of the firm of George F. Blake Manufacturing Co., Liberty st., New York, builders of the new high duty pumping engine at the main pumping station of the Toronto Waterworks, has taken up his residence at 281 Sherbourne st., Toronto.

Mr. Chas. A. Bassett, of St. John, P. Q., has been appointed District Superintendent of the Bell Telephone Company of Canada over the district south and east of the St. Lawrence. We congratulate the company upon securing the services of such a well qualified man.

While Mr. Eckert, the manager of the Bell Telephone Company at Brantford, was helping to fix a wire over the Grand river, he carried an end round his waist and was dragged within a few inches of the river by some moving ice, but succeeded by a desperate effort in securing a foothold. We congratulate Mr. Eckert on his narrow escape.

CARBONS AND PORCELAIN

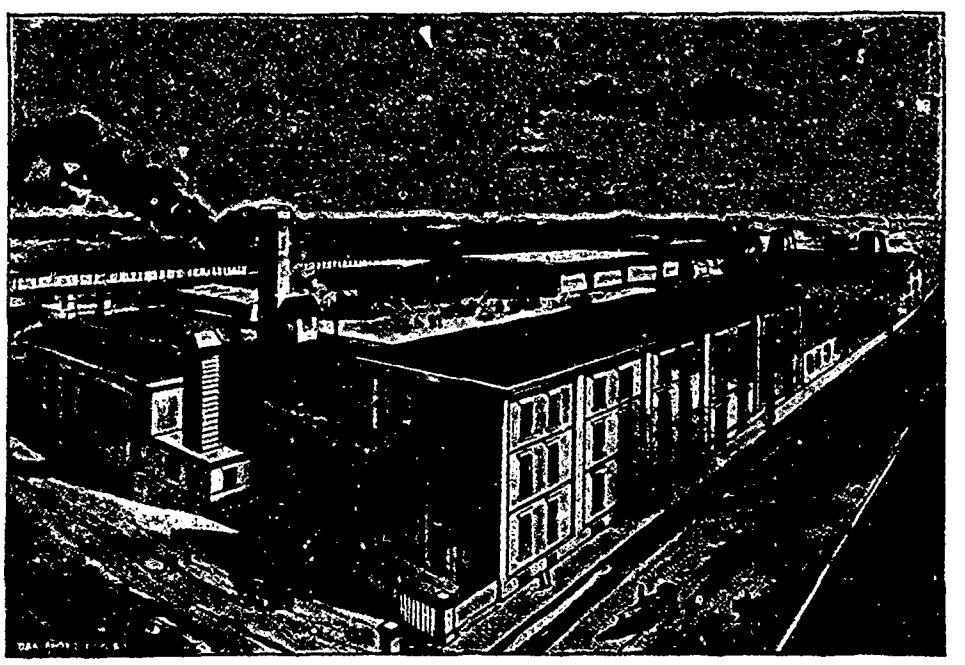
OF THE HIGHEST QUALITY ARE MANUFACTURED IN CANADA.

PETERBOROUGH CARBON AND PORCELAIN COMPANY.

SKETCH OF AN IMPORTANT CANADIAN INDUSTRY.

THE accompanying illustration represents the business offices and manufactory of the Peterborough Carbon and Porcelain Company, situated at Peterborough, Ont. The readers of the ELECTRICAL NEWS will no doubt be interested in learning some particulars regarding the establishment and development of this enterprise, which is the only one of its class in Canada.

Prior to 1890 all the carbons required for the Canadian market were supplied from American manufactories. The rapid growth of the electric lighting industry in the Dominion, however, led to the formation at Peterborough, in January, 1890, of the Brooks Manufacturing Co., who immediately commenced the building of the necessary plant for making carbons. The management of the company was vested in Mr. Thomas Brooks, with Mr. J. W. Taylor as Mechanical Superintendent and Secretary-Treasurer.



WORKS OF THE PETERBORO' CARBON AND PORCELAIN COMPANY, PETERBORO', ONT.

In April, 1890, the company commenced to manufacture, with a staff of 30 workmen, which was increased during the year to 50. Owing to the quantity of sulphur contained in Canadian coke, great difficulty was experienced in attempting to produce carbons of the required standard of quality and much loss of time and expense were sustained in replacing poor stock.

Just when these difficulties had in a measure been overcome, the company's factory and plant were destroyed by fire, March 17th, 1892. No time was lost in erecting new and commodious buildings, furnaces and machinery, and in less than two months from the date of the destruction of the old factory, its successor was in full operation, since which time the difficulties of manufacture have diminished to a minimum, and the quality of the product has been raised to the highest standard. The company has continued to enlarge its sphere of trade, until at the present time, *about eighty per cent. of the trade in the Dominion is supplied from these works.* This is still growing, and it can safely be predicted that it will only be a short time before the whole Canadian trade will be supplied with Canadian carbons. Last year the company were unable to fill many orders on account of their limited capacity. This had to be remedied so that the growing demand could be met. In order to do this an addition has lately been erected to the furnace room and a double furnace put in, which will almost double the output of the works. The addition is 45x27 feet and the new furnace is double the capacity of the old ones. With this additional furnace capacity, the works will now have a total output of *500,000 carbons per month*, making the year's output *six million carbons*. An addition has also been made to the plating room, increasing its capacity in accordance with the doubling of the furnace output. The number of employees has also been increased to eighty.

Having determined to manufacture also porcelain goods for electrical and other purposes, the need of a more significant name became manifest, and on December 14th, 1892, an Order in Council was passed by the Ontario Government authorizing the company to change its name from the "Brooks Manufacturing Company" to the "Peterborough Carbon and Porcelain Company."

In connection with this change of name, the *personnel* of the company was somewhat changed as follows:—

President—W. Cluxton.

Vice-President—Jas. Kendry.

Managing Director and Secretary-Treasurer—J. W. Taylor.

Directors — Thomas Brooks, George Stevenson, James Stevenson, M.P., Geo. A. Cox, T. E. Bradburn and A. L. Davis.

In the manufacture of porcelain goods the company bids fair to achieve as great success as in the production of carbons, the volume of their business in this department having doubled within the period of two months and the porcelain has the reputation of being superior to any brought into Canada. Among the great variety of porcelain goods manufactured are electric insulators of all designs, switch bases of different styles, ceiling rosettes, lamp sockets, main line and branch cut outs, door knobs, castor wheels and numerous articles of special ware required in different manufactures. The company has an order for supplying 26,000 pieces to the Bell Telephone Co., another order for special blocks for the electric lighting apparatus and fixtures in the new Parliament buildings in Toronto, and are supplying most of the carbon brushes and porcelain goods required by the General Electric Co. Since the re-organization of the company great changes and inprovements have been made in the offices at the works. As they are arranged the offices are bright, cheerful and complete in all conveniences, while they have been furnished in a style which gives them an air of taste and elegance as well as comfort.

SPARKS.

A storage battery is to be used by Briggs Bros., of Hamilton, to drive their milk waggons.

The electric light company of Prescott, Ont., will install an 800 light incandescent plant.

The Gananoque Electric Light Company intend to erect a new power house and make additions to their plant.

A new telephone company is to be formed in Pembroke with rates considerably lower than those at present existing.

An electric railway is to be built under the river Thames, London, Eng. The line will be laid 77 feet below the surface.

The Niagara Falls Electric Light Company have replaced their 100 h. p. engine with one of 150 h. p., and added another 100 h. p. boiler.

A company for the manufacturing of the Wooley electro-magnetic apparatus has been granted a charter by the Ontario Government. The capital stock is $25,000.

The Hamilton Street Railway Company are increasing their power. They have added to their plant a Tandem compound condensing engine of 250 h. p., also two suitable boilers.

The Toronto and Richmond Hill Street Railway Co., are completing arrangements for laying their tracks. They have been negotiating for the supply of the required motive power, but find it will be cheaper to purchase and use their own plant. It is probable they will adopt this course.

The Ottawa Electric Street Railway Co. propose extending their service to Hull, and have offered to pay the city council for the privilege $100 per mile for the first fifteen years, $200 for the next ten years, and $300 for the following ten years, if they are granted a charter for thirty-five years.

The directors of the Hamilton, Waterdown and Guelph electric railway have decided to engage an electrical expert from Toronto to advise the company as to the dynamos to employ, and to give a general estimate of the cost of the electrical plant required. Engineer Keating is likely to be engaged for this purpose.

The Toronto Street Railway Company are taking steps to prevent accidents through passengers on their open cars getting on or off on the wrong side. Wire guards will be fastened along one side of the car covering the steps at either end and extending up to a point two feet above the seats. This arrangement will also prevent passengers while sitting down from putting their heads out, and no one can hang on the step. Engineer Keating has given his approval to the guard.

The Royal Electric Company held its annual meeting recently. The report of the year's business is very satisfactory. The gross receipts were $189,765 and the gross expenditure $118,967, leaving a balance of $70,797, or over 10% on the capital. Dividends to the amount of $52,092 were paid out of this amount, and $18,705 was carried to the profit and loss account, which now amounts to $267,639. The directors of the company are Hon. J. R. Thibaudeau, Sir Joseph Hickson, and Messrs. T. L. Beique, G. R. Robertson, E. A. Small, J. Alex. Strathy, A. R. McDonnell, H. S. Holt and David Morris.

The Bell Telephone Company have sent in two tenders for providing Montreal with an electric patrol system, the first being $21,757.50 for a complete electrically equipped system of six circuits, exclusive of conveyances and horses. This was according to the instructions of the police committee. The second tender is the company's idea of what would be a complete outfit. It comprises 100 alarm stations with six circuits, with full alarm apparatus in the central station with connections to the stables. Their price for this outfit is $23,007.07. They agree to carry the wires on their poles and keep them in repair for $2,000 per annum for 100 stations, which is at the same ratio as Toronto pays for 60 stations. Mr. Badger, city electrician, is to make a full report on the tenders.

At a recent annual meeting of the Canada Mutual Telegraph Company and the Mutual Telegraph Company the following officers were elected: Mr. H. P. Dwight, president; Mr. T. F. Clark; of New York, vice-president; Mr. D. G. Perry, secretary and treasurer; Messrs. C. A. Tinker and A. S. Irving, directors.

The annual meeting of the Toronto Electric Light Company was held recently. The report shows that quarterly dividends were paid at the rate of eight per cent., and $25,000 was added to the reserve fund which now amounts to $45,000. The directors for the year are Messrs. A. H. Campbell, W. H. Howland, S. F. McKinnon, Henry M. Pellatt, S. Trees, T. Walmsley and H. Blaine, with J. J. Wright as manager.

The Canadian General Electric Company has amalgamated with the Peterboro' and Ashburnham railway for the purpose of operating an electric road in Peterboro'. The undertaking will be carried out under the charter of the latter company. The officers are as follows: Mr. T. E. Bradburn, president; Mr. F. Nicholls, vice-president; Mr. A. P. Pousette, secretary (pro tem.), with Messrs. H. P. Dwight, T. G. Hazlitt, A. Stevenson, E. H. D. Hull and W. Walsh as directors.

The Toronto and Scarboro Railway are making rapid progress with the work of laying their line of the new railway in East Toronto. Two miles of grading is completed with turnouts at the Woodbine, Norway, East Toronto and Blantyre Avenue. The rails are now being laid and the Company expect as promised to be operating this section of their road by the 24th of May. The work is being carried out under the management of Mr. John Galt, C. E., whose assistant is daily on the ground superintending the operations. The company have completed arrangements with the Toronto Electric Light Company to supply the necessary motive power, and a wire for this purpose is now being strung from that company's station on the Esplanade along Front street to George and then along King and Queen streets to the Woodbine. Mr. A. W. Dingman, manager of the street railway company has purchased from Messrs. Patterson & Corbin, of St. Catherines, two vestibule cars supplied with Thomson Houston w. p. motors of 25 h.p. each, and furnished with a Taylor truck.

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