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STEAM JACKETS AND SEPARATORS.

BY J. MURPHY, MONTREAL.

(A Paper read at the Convention of Stationary Engineers, Toronto.)

It is not my intention to take up the time of this convention with a long paper, but simply to put before you some of the points which have come under my observation while practically in charge of condensing and compound condensing engines *versus* compound condensing jacketed engines, and some of the attachments which have been devised for safety and economy on the plant where I am at present employed, namely, the Montreal street railway power station.

I will not discuss the merits of the steam jacket, for I know well that I would be treading upon dangerous ground, as there is a great difference of opinion even among some of our ablest men, who are far more able to reason the fine points than I am, but will confine myself to my experience in practice while in charge of the different types.

I will commence my subject with the steam jacket and separator, as I have found them in my practical experience in the short space of time that I have been working with the jacketed engine and separator. I have seen wonders with regard to good running and efficiency, but it is not my intention to advertise those builders that have already adopted the jacket, it is simply to lay before you what I have found in practice. I will now describe as briefly as possible the way that the steam connections to this class of jacketed engines are designed. The high-pressure cylinder jacket is supplied from the high pressure steam chest of the engine, and the receiver jacket is supplied from the high-pressure cylinder jacket; the return pipes from the jackets are run to a pump that is situated below the level of the return pipes, and the water that is condensed in the jackets is pumped automatically back to the boilers. The low-pressure cylinder jacket is supplied from the initial pressure of the low-pressure cylinder, and the condensed water from the low-pressure jacket is also pumped back to the boilers automatically with a pump similar to the one for the high-pressure jackets. These pumps can be regulated and worked by hand in case of any disarrangement of the automatic regulating gear. There is also an independent way of draining these return pipes into a cesspool connected with the sewer that is used when making repairs to these pumps, so that you will see there is no further loss than that which is due to radiation. The steam separator is connected with the main steam pipe about ten feet below its level, and at the end of it, so that any water that may get into the main pipe through condensation or otherwise may find its way to the separator, and is pumped back to the boilers by the high-pressure jacket pump. The separator effects a considerable saving because there are no other drips necessary on the main steam pipe, while such are required on the ordinary steam pipe that is not connected with a separator.

In the Royal Electric Company's works, where I was employed as second engineer for a number of years, they had the Brown and Corliss engines, working both condensing and compound condensing. That these engines worked well goes without saying. The compound engines were the latest installed at their works, and when I say that these engines worked well I simply say the truth. They carried a big load and at times a great deal more than they were built for, and they did it well, at least as well as could be expected from them under the circumstances. I am now, however, thoroughly convinced that had those engines been jacketed they would have done a great deal better, as my experience teaches that engines jacketed of similar dimensions working on similar loads and conditions, work far better. In the Montreal Street Railway power station, where I have been employed for the past five months, they have cross compounding condensing engines of the Corliss type, jacketed as I have already described. These engines are rated at 600 i.h.p., on a coal consumption of $1\frac{3}{4}$ pounds of coal per one horse power per hour, but they have been carrying for the past three months, through the day and part of the night, an average of about 900 to 1,000 i.h.p., and sometimes a great deal more, and they do it as well as if they were only running at their rated capacity, and that they do it with fair economy will be seen from the following data, hastily got together for this occasion:

The dimensions of the cylinders are as follows.—The high-pressure cylinder 24 inches diameter, with 48 inches stroke, low-pressure cylinder 48 inches diameter by 48 inches stroke. The valves of the engine are arranged so that the engine may carry steam the whole of the stroke if necessary. They do carry steam the whole length of the stroke when the load comes on suddenly. Each engine carries 4,200 kilo-watt generators, with an average of about 300 amperes, at 550

volts each; they do at times reach 400 amperes, but 300 is about the average. Taking the horse power electrically as my standard, I find that these engines are developing an electric horse power that is equivalent to a mechanical horse power on from 2 to 2⅛ pounds of coal per hour under all conditions.

I have computed the horse power of the ordinary compound and condensing engine of the latest improved type, and from the same data, namely, electric horse power, I have found that 2¼ lbs. of coal per horse power, under all conditions, was the best they could do.

Now there is something more to be said about the jacketed engine before I conclude, and that is that the joints stand better than on the ordinary compound engine; and, contrary to my expectations, the packing stands equally well if not better than in the ordinary compound engine. These engines are easy to start, because there is no water to contend with; the separator keeps the main steam pipe free of all water that would otherwise have to be drawn off by drips, and there is no more trouble with the engine after she is started from this source than there was before she started up; this in itself is a great relief to the mind of the engineer when he knows there is no danger from that most dreaded of all things—water.

I have given a few of the facts on which I base my judgment of the jacketed engine, and I will now conclude by saying that you have to run a jacketed engine with separator attachments to the main steam pipe, to know its worth.

An interesting debate followed the reading of Mr. Murphy's paper at the convention of Stationary Engineers.

In reply to a question from Robert King, of Kingston, Mr. Murphy said they had used screened coal and had also used cinder screens and hard pea coal mixed. His figures were only approximate, but while he had no detailed statistics, his conclusions were such as to satisfy himself that the jacketed engine was the most economical. Replying to Mr. Mitchell, of London, he said the Lancashire boiler was used, but they had also used the Babcock boiler.

Mr. King said that at their plant in Kingston they took refuse and hard coal screens, first trying equal parts, and then two to one. They had also mixed three parts of hard coal and one of soft, and had got one horse power (indicated) out of 1⅞ lbs. coal, running an Inglis & Hunter condensing engine 16 x 30, 42 in. stroke. They were at this moment running a twelve-hour test on pea coal, which cost $3.34 a ton laid down in the yard. The other coal from which a horse power was got on 1¾ lbs. cost $2.95 a ton.

Mr. Murphy said the engine used in Montreal was 24 x 48, 48-in. stroke, and they had on the road 110 motor cars and 76 trailers. He wished it understood that the engines there were not working economically. If they were it could be got down to 1¾ lbs.

Mr. Edkins bore out the last statement, and said there was a wide difference between the work required of the two engines. Enormous loads had at times to be carried on these engines, and one could not get economical work, for the reason that part of the stroke was cut off when there was a sudden lightening of the load.

Mr. Wickens thought it was plain that there was a good deal to be said on both sides. Some of the best engineers tell us that the steam jacket is of no use, and they go into figures and explain it; while others equally eminent answer us that the jacket is of great benefit, and back their opinions up with statistics.

For THE CANADIAN ENGINEER.

THE INJECTOR.

BY ALBERT E. EDKINS, TORONTO.

When we take into consideration the vast number of injectors that are in use for feeding steam boilers, it seems somewhat strange that the principles which govern their action are not more generally understood. Probably there has been no other appliance placed in the hands of the engineer for operation of the principles of which he has known less, and yet has been able to work so successfully.

In speaking of the principles which govern the action of the injector, I wish it to be distinctly understood that I do not allude to the pages of complex formulæ and matter to be found in every scientific work on the subject, and which are too far advanced for men of limited education to understand; but what I allude to as the principles of the injector is the common, every day principle involved, and which can be readily understood by any engineer who can read, and is endowed with ordinary intelligence.

We can well afford to leave the formulas for the proportioning of the jets of the injector to the scientist and the makers of them; but what we want is to know sufficient of the principle of the instrument to enable us to keep it operating successfully, and in case of a failure to be able to detect the cause thereof. It is with these things that this paper is calculated to deal.

The injector, we are told, was invented by Gifford over thirty years ago. I have heard it said, or I have read it somewhere, that the original inventor was experimenting with some apparatus on a steam boiler, when he found to his surprise that it was possible to inject water into a boiler by utilizing the steam pressure of the same boiler. This seemingly paradoxical result was very much wondered at, and we can easily imagine that it would be looked upon by many as an utter impossibility.

Referring to Diagram No. 1, to a person having no knowledge of the subject, it does certainly look unlikely that water could be forced into a boiler by the very steam generated within it, and this too (as is often the case) in the bottom of the boiler, where the pressure is greatest, in consequence of the height of water in the boiler.

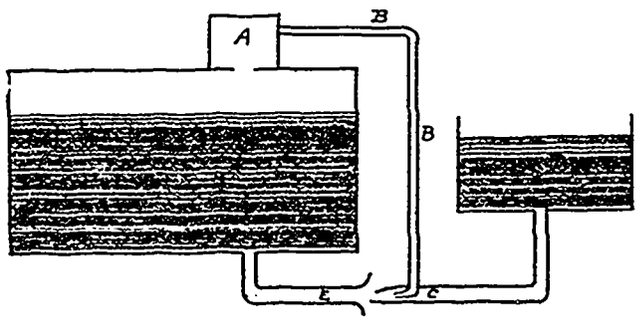

DIAGRAM 1.

Diagram 1 represents a section of the injector, and boiler also, from which the injector takes its steam to operate it in feeding water into the bottom of said boiler. A represents the dome or steam space from which is carried a steam pipe B, which is connected to a cone C, which is connected to a tank full of water D. The cone C is connected to another pipe or cone E, through which the water is driven into the boiler.

All valves and cocks are left out in the sketch, as they are not necessary for illustration.

To a person unacquainted with steam engineering,

the idea of this arrangement of tubes forcing water into the same boiler from which it is supplied by pressure to operate it, might look absurd or impossible, but to us, as operative engineers, it is quite feasible; in fact we see it in successful operation every day.

We will now find out what would be the velocity of steam issuing from an opening of one square inch. If the pressure in the boiler be five atmospheres, or 75 lbs. per square inch, and the temperature of steam at this pressure be 307°F., the weight of 12 cubic inches of steam will be ·001149 pounds.

As the steam has to flow out against the atmosphere, the effective pressure, to which the flow would be due under above conditions, would be 75 lbs. —15 lbs.=60 lbs. per sq. inch. If we take a pipe with . sq. inch area, and we need to put in that pipe 60 lbs. of steam (*i.e.*, 60 lbs. weight of steam), how long must the pipe be?

To find the necessary length of pipe we have only to divide the total weight, or 60 lbs., by the weight of 12 cub. in. of steam, under a pressure of 60 lbs. per sq. inch, which is ·001149 lbs.

This will give us $\frac{60}{.001149}$ = 52,218 feet.

If we now take the formula given by D. K. Clarke for determining the velocity of steam flowing from orifices into the atmosphere, viz.:

$V = 3.59 \sqrt{h}$.

Where V = velocity in feet per second,
h = The height or length of a column of steam at the given pressure and of uniform density,

Then we have 52,219 (228.4 = feet

4
42) 122
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448) 3819
3584
4564) 22500
18256
·4344

Then 228·4
3·59
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11420
6852
819.956 = velocity in feet per second, which steam at 60 lbs. will flow into the atmosphere at constant density.

Dr. Kinnear Clarke tells us that the lowest initial pressure for which the preceding formula for determining the velocity can be safely used, is 25·37 lbs. per sq. inch. This formula has been borne out, we are told, by the experiments of Mr. Brownlee.

There is a point regarding the flow of steam through orifices which I have only become acquainted with myself since studying up the matter for this paper, and I thought it well worthy of mention. It is this: The flow of steam of a higher pressure into a space of a lower pressure, such as the atmospheric, increases as the difference of pressure is increased, until the outside pressure is reduced to 58 per cent. of the absolute pressure in the boiler.

The flow of steam is neither increased nor diminished by reducing the outside pressure below 58 per cent. of the inside pressure, even though the outside pressure be reduced to a vacuum.

This fact was a most surprising thing when made known to me a short time ago, and I have no doubt but that it will be the same to some of my hearers in this room.

But to return to my subject. We find that steam at 75 lbs. pressure will flow into the atmosphere with a velocity of 819·9 feet per second, but this is the velocity of efflux at constant density, and D. K. Clarke tells us that the *actual* velocity of efflux expanded at 75 lbs. (absolute) is equal to 1,446 feet per second. Therefore the velocity of steam issuing from an orifice of 1 sq. inch, in a boiler carrying a pressure of 75 lbs. per sq. inch, will be 1,446 feet per second.

We will now assume that we have an orifice of 1 sq. inch in the bottom of a steam boiler, the pressure inside the boiler being the same as before, and we require to know the velocity with which water will issue from the orifice, under precisely the same conditions as in the case of steam.

Of course there will be a slight increase of pressure in the bottom of the boiler, due to the height of the water line in boiler, but as it is small, we may leave it out of the question.

Using the same method as we did for the steam (with the exception of the weight of 12 cubic inches of steam), we have now to use the weight of 12 cubic inches of water, or ·4.4, and the formula will now be

$V = 8 \sqrt{h} = 92·8$ feet per second.
Where V = The velocity of water in feet per second,
h = 136 feet, or the height of a column of water equal to a pressure of four atmospheres.

Then we have— feet
136 (11·6 x 8 = 92·8 feet per second
1
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We now have it that steam, under a pressure of four atmospheres, will issue from an orifice of 1 square inch area at the rate of 1,446 feet per second, while the water under the same conditions will only issue at the rate of 92·8 feet per second; this means that steam will issue from an orifice with a velocity sixteen times greater than water. Notwithstanding the greater velocity of steam over water, as shown, the latter could not be forced into the boiler against its own pressure, because the momentum of the two streams is equal, because it is due to the same head or pressure.

The momentum is the product of the mass X, the velocity with which it moves, and is expressed in formula thus: $V \frac{W}{g}$ = momentum.

Where $\frac{W}{g}$ = the weight W divided by the acceleration of gravity g, which is equal to 32·2 feet per second (= momentum). The acceleration of gravity is the force (expressed in feet per second) which the earth exerts over falling bodies, in excess of the weight of the falling body itself, and is = 32·2 feet per second.

A given force imparts velocities to two bodies, inversely proportional to their mass, or their respective heaviness or density.

But by inserting the injector between the forces, we increase the momentum of the steam, and by condensing it with the water, its velocity is imparted to the water, and the stream of water and steam combined, as it were, is forced into the boiler.

A longitudinal section view of an injector is shown in diagram 4.

A is the steam cone, through which steam is admitted from boiler, and let it be distinctly understood

that this cone A represents the power of the injector. The steam, in issuing from this cone at a high velocity (as we demonstrated before), is condensed by the water flowing in through C, and its velocity is imparted to the water in the cone B. The combined stream of water and steam are then forced into the receiving cone D, where the force of water issuing from the boiler is met and overcome.

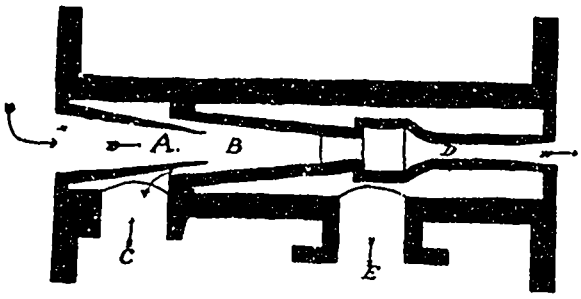

Diagram 4

The sectional areas of the cones A and D are in proportion to each other as 2·0106 is to 0·7854 (at their respective smallest diameters.)

When the water comes in contact with the steam at the outlet cone A, it is propelled along by the concentrated steam, and the water (which as you all know is nearly incompressable) is projected into the delivery cone D, and thence into and through the feed check valve and into the boiler, by the impulsive force of the steam, due to its great velocity and elasticity. To sum up the principle of the injector in a short way: It is an instrument which (by the proper proportioning of its jets) takes advantage of the superior velocity with which steam issues from a boiler, as compared with water, and is capable of producing a combined jet of steam and water, flowing through an orifice or jet at a greater velocity than that at which an opposing stream of water can flow from the same boiler which supplies the steam to operate it. All injectors (and their name is legion) work on this same principle, the only difference, so far as I know, being that some are water-lifting and some non-lifting, and some are both lifting and forcing combined.

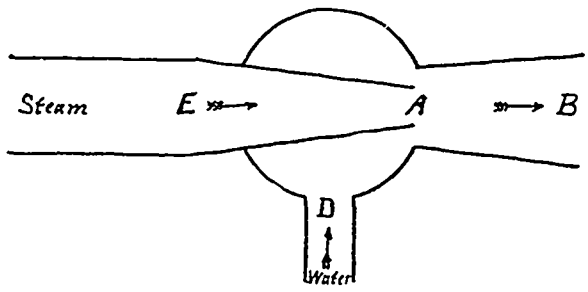

Diagram 3

In Diagram 3 we have a sketch of a lifting jet. Steam enters the pipe at E and issues at the nozzle A, and forces the air out of chamber B to the atmosphere; the air in suction pipe D immediately commences to expand itself into chamber round A, and this action goes on until there is a partial vacuum in D, and the water rises to A by the pressure of the atmosphere acting on its surface, and at A the steam is condensed, and the action takes place which has been before explained. For an injector to lift its feed water, it becomes necessary for the opening B to have considerable more area than A, as, if it were not, it would be impossible to produce a vacuum in D.

Figure 2 represents a non-lifting jet, and it will be observed that the area of the outlet of cone B is somewhat smaller than the steam cone A, and if steam be turned on at C, and issues at A, it will expand and fill the cone B, causing a pressure to back up into suction pipe C. So that with injectors of this type it is necessary for the feed water to be forced into the injector under a head, either by gravitation or from the water-works mains.

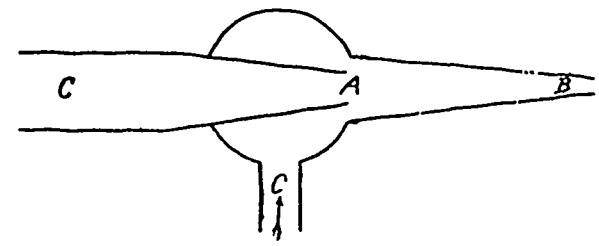

Diagram 2.

We will now briefly look into a few of the causes of failure of injectors to work.

Injectors often throw off when the temperature of water supplied to them exceeds 130° to 150°: and this is due to the fact that underneath these conditions it requires such a large quantity of water to condense and concentrate the steam issuing from nozzle A, that the velocity imparted to the water is not sufficient to overcome the opposite flow from the boiler, and, consequently, the injector kicks.

Sometimes injectors work along smoothly for hours, days, months and even years, and then all at once refuse to do their duty.

This may be due to one of several causes.

I have no doubt that some of those present have fed boilers with injectors which took their feed water from a barrel or tank, and when you have started it, and it has worked for a few minutes, and then thrown off, or kicked, as we call it, you find your water in feed tank is hot; but you say the injector started to work at first, and why not continue to do so? Simply because the injector itself may have been quite cool when it was started, and therefore it assisted in condensing the steam from nozzle A, but as it became heated gradually, and the feed water itself was too hot to cool the steam, the injector kicked, and keeps on kicking until you reduce the temperature of feed water. Again, the feed water in the tank may not have been all of the same temperature, and as the suction pipe reached down near the bottom, it worked all right until it commenced to take the water of a higher temperature which was in the top of tank when it was started, and it kicks again. The injector will always throw off when the volume of steam feeding it is not enough to give it the required velocity to overcome the opposing steam or flow from the boiler. Here too we may be inclined to say, "well, but the steam worked the injector when it was started," and that may have been so; but we must remember that the water that the injector has forced into the boiler has been, comparatively speaking, cold, and this has reduced the velocity of steam from the cone A, and the volume of water entering through feed pipe has remained constant as when the injector was started, and the necessary speed is therefore not imparted to the water with the result that injector throws off.

Then in addition to the above causes of failures, there are old-timers, well known to all engineers, viz., leaky suction pipe, no water in tank, end of the supply choked up, foreign matter in the jets of injector, hot suction pipe, etc., etc., and I have even known a check valve put on a pipe wrong end to, to prevent an injector from working. I have also known the jets to become coated with a deposit to such an extent as to alter the proportion of areas so that they would not work.

There are scores, yes thousands of engineers who use injectors of one of the many kinds; and who, in the event of its failure to work, will take it down, clean it, and remove the cause of trouble, and put it together again and make it work successfully, and yet never once think of trying to enquire into the principles which govern its action; and yet it seems to me that an engineer who is of an enquiring turn of mind (and who refuses to take a thing for granted, simply because there is abundant evidence that it is so, but who enquires into the reason of things, and posts himself as fully as he can on the principles of steam engineering), must eventually find himself in better circumstances than the man to whom it is quite sufficient to know that a thing is so, because he sees it is so, and who is quite satisfied without enquiring the reason why.

BOILER EXPLOSION AT GAGNON'S MILL, THREE RIVERS.

On the morning of the 7th September, J. A. Gagnon's saw mill, opposite Three Rivers, Que., was the scene of one of those disastrous boiler explosions which startle mill owners and cause them to think of the need of proper inspection of their boilers. Both ends of the boiler were blown out, one end being hurled into the St. Maurice River and the other into a field, while fragments of the building were scattered hundreds of feet around. The body of Sam. Beaunier, the fireman, was found a hundred feet away, with the top of his skull blown off, while the following were scalded and otherwise injured: Philip Gaudet, Daniel Loranger, legs broken; Napoleon Sanstete, wounded by broken glass; Philip Mercier, Dolphus Rocheleau; Bundock, father and son, severely injured about the face; Joseph Charbonneau, legs hurt. The mill and boiler were nearly new, and not only the mill but the boiler were uninsured, and the latter had not been inspected. The boiler was 5 feet diameter and 12 feet long, made of $\frac{3}{8}$ inch iron plate, double riveted, the heads being in two pieces. The tubes were not beaded over at the ends, and though there were gusset stays and round stays at the ends, they were not properly fastened. The holes were punched too near the stay and were found broken out. The angle irons were small and light, and the method of fastening poor. When enquiries were made into the circumstances, the proprietor and those in his employ were very reticent, and the only explanation they could suggest was that something had fallen on the safety valve. An inquest was held on the case of Beaunier, and the finding of the jury was that "the deceased came to his death by visitation of God, from a boiler explosion, and no one was to blame"—a verdict that need not be surprising considering the limited acquaintance of the lay juryman in a country district with boiler making.

It seemed a providential thing for the citizens of Montreal that the recent accident to one of the old pumping engines at the water works did not take place till just after the installation of the new Worthington engine. But the accident exhibits the foolhardy policy of the Montreal city council in trifling with so essential a thing as the water supply. Over a year ago the report of T. C. Keefer, C.E., showed the urgency of improvements to the Montreal water works, and this report was to have been submitted to the public long ago. Why has it been concealed? The excuse made for not carrying out the recommendations of Mr. Keefer was lack of funds, but while they could not spend a few thousands on making safe the water supply upon which the citizens depend for their very life, they have since spent hundreds of thousands on street paving and road work generally, some of which has been of very doubtful necessity. There are many opportunities for commissions and boodle in these street contracts, and very few in an improved water works scheme, but of course such considerations could never influence a member of the Montreal city council.

For some time there have been rumors of amalgamation between the two Montreal gas companies, and now at last the absorption of the Consumers' Company by the Montreal Gas Co. is an accomplished fact, the consideration being $700,000. There seems to be a disposition amongst some Montrealers to blame the Consumers' Co. for this sorry outcome of their hopes for competition and consequent low rates. There may be, however, another side to the story, especially when, as we hear, only 150 citizens acceded to the invitation of the new company to become customers, in spite of an energetic and painstaking canvass. This fact shows that citizens will often protest very loudly against an evil and yet be nothing but lukewarm when a practical remedy is offered. The whole history of this case shows the enormous value of a monopolistic franchise, and the question for students of municipal politics to consider is whether it is not better that such works be owned and controlled by the cities themselves. Wherever this plan has been adopted in English cities it has been found to be for the public good, especially where the management has been divested from political or other corrupting influences.

The city of Montreal has been the habitat of many conventions this summer, but only one of them appeals directly to the public, as it deals with the subject in which most of us have a vital interest, our health The American Public Health Association is an association embracing Canada, the United States and Mexico; its membership includes nearly every prominent official connected with a public board of health, and officers of every quarantine station in the countries named. Through the liberality of the Government and the city of Montreal, a delightful trip to the Grosse Isle quarantine station enabled the visitors to personally examine and enquire into every detail connected with the inspection and quarantining of an ocean ship, the disinfection and sterilization of clothing, and the system of marking the baggage after it had passed inspection. The time on the island was not spent in play; full ad-

vantage was taken of the opportunity to pick a hole, and the result was satisfactory in the highest degree, a unanimous verdict of *perfect* being rendered. The excursion was conducted by Dr. Lachappele, whose courteous manners won for him the highest respect and regard of all the visitors.

A MEETING of the General Committee of the Ontario Good Roads Association was held in Toronto on the 13th of last month. It was reported that a large amount of information regarding present expenditures on road repairs was being collected from municipal authorities and that a great interest has been awakened in the subject of road making. Steps will probably be taken to bring the subject prominently forward at meetings of farmers' institutes during the winter, and some special lectures are to be delivered at the Agricultural College. It is likely that special lecturers will be selected for this purpose, amongst whom will be some civil engineers who are turning their attention to this important public work. A movement of this nature must necessarily take time to develop. The Government of the Province of Ontario has recognized this and is doing a good work in issuing bulletins on road-making.

OFFICERS OF THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

JOHN J. YORK.

John J York, the new president of the Canadian Association of Stationary Engineers, was born at L'Acadie, Que., in 1861 At the age of 13 he was apprenticed to Prowse Bros., steam fitters, Montreal, and advanced so well that at 19 he was placed in charge of some large contracts which he carried out to the satisfaction of both employers and customers. After being a short time with John Date, plumber, he got a place in the machine shop of the St. Lawrence Sugar Refinery Co., where he was promoted to the entire charge of the mechanical plant. Owing to poor health he gave up this post about two years ago, though his pay had been substantially increased a short time before. He then went to the firm of Garth & Co, the large brass founders and heating contractors, as outside foreman, and it was here that he was put in charge of the sanitary and heating work of the new board of trade building. Upon the completion of the building he was appointed superintendent, a place which he fills now with great ability. Mr York is not only a good engineer and mechanic, but has studied electricity also, and has immediate charge of the large electric light plant of the building. He holds a first-class license as engineer from the city. Though not one of the oldest members, he is one of the most active and progressive members of the C A.S E., and his election to the highest office in the association is a testimony to his zeal and intelligence.

Walter G. Blackgrove was born in London, England, in 1861, and came to Canada at the age of 12, living first at Port Perry, Ont, and afterwards in Toronto, his present home. After some years in Canada Mr Blackgrove learned the business of an engineer, for which he has always had a natural aptitude. He has been an engineer for twelve years, the last five of which have been spent with the James Morrison Brass Mfg Co of Toronto Mr Blackgrove has been an ardent member of the C A S.E, and was for three years secretary and one year president of Toronto No. 1. His

W. G. BLACKGROVE

loyalty to the interests of the association becoming known outside of his own branch, he was elected executive secretary of the C.A. S.E in 1892, and last year was unanimously chosen treasurer. At the convention last month Mr Blackgrove was elected vice-president by acclamation, and has thus advanced step by step to the second highest position in the association.

JAMES DEVLIN

James Devlin, executive secretary of the C.A.S.E., was born at Kingston, and served his apprenticeship with the Canadian Locomotive and Engine Company He afterwards worked in D McEwen & Son's works in Kingston and in 1873 was appointed engineer of the Government water works before that department was taken over by the city. In 1875 he was transferred to the penitentiary at St. Vincent de Paul, near Montreal, where he was appointed to the post of chief engineer. In 1885 he received the appointment of chief engineer at the Kingston Penitentiary, a more important post, and left Vincent de Paul with the general regret of the staff. As a token of their good-will and esteem, he was presented by the officers of that penitentiary with a valuable gold chain and locket. Mr. Devlin, it will be remembered, was very prominently mentioned for the position of chief mechanical engineer for the Public Works Department upon the removal of Mr. Arnoldi. He joined the C.A.S.E in 1892, and took an active part in the formation of the Kingston branch last year, of which he is now president, having been also president of the local association which was formed before its absorption in the C.A.S.E. He is also one of the board of examiners of the Ontario Association of Stationary Engineers. Mr. Devlin is well known in engineering circles throughout the Dominion, and very popular, and though he hesitated at taking the position of secretary, the convention insisted on his acceptance of the office.

DUNCAN ROBERTSON.

Duncan Robertson, who has been elected to the responsible position of treasurer of the C.A.S.E., was born in Ayrshire, Scotland, and served his time as an engineer in Kilmarnock. He came to Canada twenty-five years ago, settling in Hamilton, where he still resides. For eighteen years he was in the mechanical department of the Great Western Railway there as machinist, and on the absorption of the G.W.R. by the Grand Trunk he went to the D. R. Dewey Coal Co., where he was appointed manager, a position he still holds. Mr. Robertson is an able debater, and his remarks are always listened to with attention and respect. His business capacity will qualify him for his present office. We regret that a photo of Mr. Robertson has not arrived in time to be engraved for this issue.

E. J. PHILIP.

E J Philip, who has been elected conductor in the C A S.E., was born at Southampton, Ont. He went into the world to work for himself at the age of 11, and served his time in Galt. He was afterwards for two years engineer for the Toronto Incandescent Electric Light Co., and is now chief engineer for the T. Eaton Co., whose large steam, electric lighting and hydraulic plant he manages with much ability. Though Mr Philip is only 28 years old, he has already become prominent and popular in the engineers' association, being now president of Toronto branch. The prospects for Mr. Philip are certainly among the brightest, considering the advancement he has already made

J. F. CODY.

J. F. Cody, who was elected doorkeeper of the C.A.S.E., was born on Grand Island, near Niagara Falls, his father having moved there from Oxford Co., Ont Mr. Cody started in life as a machinist, and after working at this trade five years, began to study marine engineering and qualified himself as an engineer in the United States. He served for ten years on vessels on the lakes, and in the latter part of this period was promoted to the position of chief engineer of the steamer "C. F. Bielman," of Detroit. Subsequently he was offered a position as traveller for the Standard Oil Co., who almost invariably select their travellers from the ranks of the engineers. Mr. Cody now occupies the ground for that large corporation in Toronto and Eastern Ontario. He is a popular member of the Stationary Engineers' Association and shows a lively interest in their work. It was chiefly through his exertions that the Wiarton branch was formed. He is also a member of the Marine Engineers' Benefit Association of the United States.

An educational meeting of Montreal Branch No. 1, Canadian Association of Stationary Engineers, was held last month. Several interesting problems were figured out on the blackboard by Bros. Huntingdon and Nadin. The association is doing much good in educating and fitting the Montreal engineers for the work. J. H. Garth was elected an active member.

At the regular meeting of Toronto Branch, C A.S.E., it was stated that the accounts in connection with the recent convention were not all in order yet. Among the queries in the question box was one as to whether japonica was to be recommended as a boiler purge. The general opinion of members was that it was not when used alone, as it adhered to the tubes and gave trouble. A mixture of 7 parts of sal soda and 10 parts of japonica was, however, said to answer the purpose very well.

It frequently happens that when one is seeking to do good to a neighbor one benefits himself. Mr Edkins, in concluding his paper on injectors, printed elsewhere, illustrated this in the following remarks: "I assure you that it has been a pleasant duty to me to get up this paper, and I feel that in doing so I myself am benefited to a far greater extent than any of my hearers, and I would advise any of our members, who feel that they lack information on a subject, to start and write a paper on it at home in the evenings, and take plenty of time over it, and it will surprise them to find the good it will do them."

At a meeting of the Kingston branch C.A.S.E., held last month, J Devlin and R. King, delegates to the convention in Toronto, gave an account of the proceedings there and distributed souvenirs of the convention, containing views of Kingston, Toronto and Montreal. They also gave away copies of THE CANADIAN ENGINEER, which contained photographs of the delegates, taken in Reservoir Park, Toronto. During the stay of the delegates in that city seven aldermen entertained the visitors at the expense of the corporation. Bro Devlin says the convention will certainly be held in Kingston in 1896.

A branch of the Canadian Association of Stationary Engineers has been organized at Brockville, with W. F. Chapman as president, George Whitney vice-president, A. Franklin treasurer, and J. Atkins secretary. Rooms have been secured and a committee appointed to furnish them.

CANADIAN ELECTRICAL ASSOCIATION.

THE FOURTH ANNUAL CONVENTION.

The Canadian Electrical Association held its fourth annual convention in the Board of Trade Buildings, Montreal, on the 19th, 20th and 21st ult., the president, J. J. Wright, in the chair.

Among those present were: L. B. McFarlane, W. B. Shaw, John Carroll, D. A. Starr, Fred. Thomson, G. W. Sadler, Geo. M. Wight, Hiall Brown, Chas. C. Paige, W. G. Slack, Robt. F. Jones, C. B. Powell, F. W. Atkinson, E. B. Biggar, G. H. Hill, J. Hunter, J. Green, L M. Pinolet, Montreal; K. J. Dunstan, A. B. Smith, C. H. Mortimer, W. A. Tower, T. R. Rosebrugh, John Langton, Wm. Bourne, J A. Baylis, J. A. Kammerer, A. M. Wickens, J. C. Gardner, Geo. White Fraser, Toronto; J. E. Brown, D. H. Keeley, O. Higman, C. F. Medbury, D. C. Dewar, Ottawa; W. R. McLaughlin, New York; Geo. Black, W. F. McLaren, Robert Dickinson, Hamilton; J. W. Taylor, W. P. Roper, Peterborough; A. W. Wright, C. H Wright, W. A. McKay, Renfrew; R. G. Moles, Arnprior; Chas A Bissett, St. Johns, Que.; E. Carl Breithaupt, Berlin; Chas. F. Ernst, New Hamburg, Ont.; John Yule, Guelph; J. M. Campbell, Kingston; Andrew E. Sangster, Sherbrooke. Thomas D. Lockwood, advisory electrician of the American Bell Telephone Co., Boston, and F. S. Francisco, president National Electric Light Association, of Rutland, Vermont, were among the visitors from the United States.

In opening the convention, the president expressed his pleasure at meeting so many, and was especially glad to welcome representatives from the sister associations in the United States. He also congratulated the association on the quality of the papers presented at the convention.

The secretary, C. H. Mortimer, then read his report, a summary of which is as follows:

The association's year, which closed on the 31st of May last was a comparatively uneventful one, apart from the convention held in Toronto a year ago, which was admittedly the most interesting held up to that date, but which would be eclipsed by the present. Three meetings of the executive committee had been held since the last convention. At the first of these payment was ordered of the accounts in connection with the convention; several new members were elected, and on motion of Messrs. Black and Smith it was resolved that new members joining the association in the *interim* between two annual meetings will be entitled to membership until the close of the ensuing annual meeting, at which time their membership fees again become due At the second meeting arrangements for the present convention were considered, and papers were invited from various members, all of whom accepted, save three. At the final meeting the president and Mr. Kammerer were named a committee to make arrangements for the present convention, and a sum of $100 placed at their disposal for the purpose.

The number of active members on the role of the association was 99, and of associate members 38.

The following was a statement of the receipts and disbursements for the association year ending 31st May, 1894.

Receipts.

Cash on hand June 1st, 1893	$ 6 30	
Cash in bank " " "	97 18	
63 active members' fees	315 00	
26 associate members' fees	52 00	
J. M. Campbell, to cover exchange on cheque	15	
Ladies' tickets to Niagara Falls	8 00	
		$478 63

Disbursements.

Expenses of Convention at Toronto		
Lunches at Cliff House	$27 50	
Dinner on "Chicora"	27 00	
J. A Kammerer, expenses incurred for Association	4 35	
	58 85	
Reporting proceedings of Convention	26 80	
Grant to Secretary	25 00	
Postage	27 00	
Printing and stationery	65 00	
Receipt book	25	
Exchange on cheques	75	
Refund to W A Green for dinners at Cliff House	1 50	
		205 15
		$273 48
June 1st, 1894		
Cash on hand	$ 23 30	
Cash in Merchants' Bank	250 18	
		273 48
Total cash on hand, June 1st, 1894		$273 48
Receipts since June 1st, 1894		
7 active members' fees	$ 35 00	
3 associate members fees	6 00	
Capt Carter	2 50	
D Robertson	1 00	
	$44 50	
Expenditure since June 1st, 1894	17 04	
		27 46
Total cash on hand, Sept 18th, 1894		$300 94

The report was adopted

Ten active members and five associate members were elected

John J York, president of the Canadian Association of Stationary Engineers, accompanied by G Hunt, past-president, A. M. Wickens, and J Robertson, was then introduced, and on behalf of that association read an address of welcome to the convention. He congratulated the association on the remarkable advances which have been made and still continue to be made in electrical science, and pointed out the close and fraternal relations of the electrical and the stationary engineer, and the mutual help they were affording each other

Mr York's address was received with applause, and the president thanked him in the name of the association for their kindly welcome to Montreal He also extended a warm welcome to any members of the C.A S.E. who wished to take part in the discussions

On the suggestion of K. J. Dunstan, T. D. Lockwood, of Boston, advisory electrician of the American Bell Telephone Co., and S F Francisco, president of the National Electric Light Association of the U.S., were elected honorary members They were the first gentlemen to enjoy that distinction.

K J. Dunstan moved, seconded by A. B Smith, that the constitution be so amended as to reduce the fee for active membership from $5 to $3.

On amendment by E Carl Breithaupt, seconded by J A. Kammerer, Messrs. Smith, Dunstan and McFarlane were appointed a committee to consider the question.

It was moved by A. B. Smith, seconded by J A. Kammerer, that all existing committees be dispensed with, and that committees be nominated by the president on Legislation, Statistics, and Constitution and By-laws Carried.

The president read a communication from Mr. Paige, manager of the Packard Lamp Co., inviting the Association to visit the Queen's theatre that evening (19th).

At the afternoon session the president nominated the following to serve on the various committees:

On Statistics—E Carl Breithaupt, Berlin, John Langton, Toronto; John Galt, Toronto.

On By-Laws and Constitution—J. J. Wright, J. A. Kammerer, A M. Wickens, A. B Smith, and K J Dunstan, all of Toronto.

On Legislation—C Berkeley Powell, Ottawa; L. B. McFarlane, Montreal, John Yule, Guelph

These nominations met the approval of the meeting, and were adopted.

A paper by W B. Shaw, on the "Application of electricity for medical and kindred purposes, from light and power circuits," was then read, and will be referred to in another issue.

J. A. Baylis, of Toronto, then read a paper on "Electrolysis," which will be found in another part of this issue.

In the course of the discussion on the paper, Mr. Black, of Hamilton, said there was a good deal of talk of damage in Hamilton from electrolysis, and the city engineer had a pile of pipes in his office as samples of the effects, but this was in the days when they used the old strap rail and the bonds were broken. Those familiar with the position of Hamilton would remember that the main return circuit ran down James street. The single track ran to the power house and York street, King street, Barton street branched off The whole current had to be returned to this one set of strap rails, and when the strap rails were worn the bonds broke, and the current would get off some other way Since they have laid the new rails and made their bonding there has been no complaint. All the pipes taken out were in the neighborhood of, and not very far from, the power house They were not found injured in any other place than in the neighborhood of the power house. The city engineer had gathered quite a mass of information, and he intended calling on him to see if he could give us anything on the subject for this meeting, but did not see him. Mr Black understood the railway company have now connected the main water pipe with their ground wire at the power house, and that reduces the chances of further trouble.

Mr Shaw said if electrolysis were occasioned by the polarization of gases, that would cause an even wearing away of the pipes right along, but there is not an even wear

Mr Keeley found that wherever there was a marked effect on the cable, the ground would be very moist at that point Here was a piece taken from the vicinity of the power house in Hamilton and it looked as if it had the small-pox It had evidently been in water. Possibly the water may have passed through a limestone formation.

Mr Lockwood said the subject of this paper was important to the telephone man, and important to the railroad man, because he naturally does not want to interfere with other people's belongings any more than he can or must. There seems to be one thing that paper might have mentioned, and that is, that a great deal of this electrolytic corrosion of underground cables is dependent on the amount of electricity that is pumped into the earth within a given area of space. The most noticeable instance of this kind occurred in Boston, which had the largest installation of electric street railway in the world, and there the largest currents were brought back to the dynamos through the earth. He was a little surprised in learning from the paper that the first remedy tried was grounding the positive pole at the dynamo and putting the negative pole to line He believed that the dynamos of that company ordinarily had their negative pole to line, and that it was not until their attention was called to the fact that they changed it and put the positive pole to line. With the negative pole to line, so large is that system and so enormous are the amounts of electricity delivered to the earth after passing through the trolleys and the motors, that the electrolytic corrosion of pipes and cable tubes was in all quarters In fact, it spread nearly all over the city, and it was as a suggested remedy that the present method was adopted, in which the positive pole of the dynamo is to line. It does restrict the trouble to a small area immediately around the power station, and when it is restricted to such a small area it is much more easily handled than a corrosion distributed around a large city. In addition, extremely large copper cables are used. In Boston copper cables of more than one inch in diameter have been employed to aid the rails in returning the trolley current, and the trouble is very largely minimized. Personally, he did not think that in small installations of electric railroad serious trouble need be expected, but in large cities it is to be expected. The bonding of the rails is no doubt one of the principal things that is required. He did not think that the electric welded rails have, to any great extent, gone into use yet, and the unwieldliness of handling them will be an insuperable objection. But with the best conductors that are made, we have still to remember that the old doctrine that used to be promulgated, that electricity would choose only the best path, must be discarded, not only from our lips, but also from our thoughts, and remember that electricity avails itself of all paths in proportion to their respective resistances; and when we think of that, we cannot help but see, no matter how perfectly our roads are constructed, we should make the return conductor as perfect as it can be, and it is still the best thing to have the positive pole of the dynamo to line, and to aid the rail in the vicinity of the dynamo and of the power house by very large copper conductors.

Mr. Baylis said: "That remedy was tried in Marseilles, in France, and it was strongly recommended there. They grounded the positive pole and had the dangerous area distributed over a large portion of the town, and they were experiencing no trouble, and this was commented on in an editorial in the London *Electrician*. It was stated, however, that it was not a true remedy."

Mr. Medbury observed that in Ottawa he had some experience with the engineer of the Bell Telephone Company in taking some

readings of the different potentials between the rails and the ground, and they believed that by taking readings at different manholes, they could simply connect the cables to the rails where there was the greatest difference potentially, or make the connection between the rail and that portion of the telephone cable which came nearest the power house, and in that way, of course assuming always that the cable is positive regarding the rail, do away with pretty nearly all the effects of any electrolytic action. In a small city that would entirely remedy the matter. In that case he would have the positive pole of the machine to the trolley wire. Of course the Ottawa station is located some way from the centre of the telephone cables, and unfortunately they could not measure the amount of current flowing on the cables. We did not much more than find out where the greatest action was going on and where the greatest tendency was to leave the cable.

Mr. Baylis said if one took the readings of the ammeter, taking a gas or water pipe, for instance, which is buried in the earth, and expose the pipe for seven or eight feet and put an ammeter between the pipe and the ground, one would probably get a very small current flowing. At the same time a great deal of current may be flowing from the pipe to the ground. The current is leaving the pipe all right enough, but it is not going through the ammeter.

Mr Medbury said his experience was that taking two parallel streets, the cable running down one street and the electric railway on the other street, a current going up to the farther street takes just a short cut over that cable, and the whole of that current is going down the cable. It branches off the street and makes a conductor for it. If the cable happens to turn three or four streets down there, the current is leaving the cable again. Of course, if you take it at that point and put a tap on, you are not getting any electrolytic action at all. The cable simply acts as a conductor for the twenty or thirty amperes that happen to be flowing over it. Of course, after you have got away 100 feet from that corner, perhaps there would be no current to speak of flowing around the outside of the cable; it would all be going over that cable, perhaps twenty amperes. Of course readings taken anywhere inside of that zone of electric current would give various indications according to the position at which you are taking the readings, but twenty feet from the corner you have quite a number of amperes running over the cable.

The closing paper of the day was by L M. Pinolet, on "Alternating current motors," a summary of which will appear in a later number.

On motion of A. B. Smith, seconded by H. A. Brown, votes of thanks were passed to the gentlemen who read the papers of the day.

Mr Smith presented the report of the committee on the reduction of membership fees, and Mr. Dunstan, explaining the report, said that there being a small surplus and the association not being a money making institution, it would be well to reduce the membership fee What the association wanted was more members rather than more money.

The recommendation of the committee was adopted.

A letter was read from A. J. Corriveau, of the Montreal Park and Island Railway, inviting the members to a trip over the line to Sault au Recollet.

Owing to unfavorable weather the trip to Lachine and down the rapids was abandoned.

SECOND DAY.

At about 9.30 the members met at McGill University, where they were shown through the great engineering building. Professor Carus-Wilson, of the electrical department, showed the visitors the electric clutch pulley and other appliances, the chief object of interest, however, being a special apparatus on which tests were made for the measurement of alternating current power.

When the convention assembled for business a hearty vote of thanks was passed to Prof. Carus-Wilson for his elaborate and interesting exposition of his experiments and tests.

The first paper was by E. Carl Breithaupt, of Berlin, Ont., on "Municipal Electric Lighting." It will be given in a later issue.

Mr. McFarlane placed before the convention an interesting collection of original letters, telegrams, and photographs connected with the early history of telegraphing, sent by John Horne, Montreal. Among these were pictures of Cyrus W. Field, Morse, Gray, Galvani, Ohm, Volta, and others; also a set of a paper called the *Canadian Electrical News*, published in the sixties, and of which only five numbers were issued. It was the pioneer paper of its kind, but of course lived before its time. It was edited by Mr. Horne.

At the afternoon session a paper was read by D. H. Keeley, of Ottawa, on "A Method of Distribution with Equalization of Potential Differences."

After a discussion on this paper the chairman called on O. Higman, chief inspector for the Dominion Government, under the new Electric Light Act, to give some information on the scope of the new Act.

Mr. Higman said: "One of the objections made to the Act is to clause 7, and I explained that the original copy of the draft of the Bill included a number of clauses dealing with underwriters' rules, and acting on a request from the Underwriters' Association, those clauses were subsequently stricken out. Later on, however, when the Bill was taken up, that is some few years ago, I found numbers 6 and 7 reinstated for the purpose of giving the consumer the opportunity of being able to test his wires for leakage, giving the consumer the power to call in an inspector to test the wires for leakage. The other principal objections in this article are as to the utility of this inspection. This is a matter of opinion. The Canadian Government has thought fit to inaugurate a system of weights and measures inspection, and that system has been in operation for the past twenty years, as to weights and measures for the sale of ordinary commodities that we can feel and handle. If it is necessary we should inaugurate a system of dealing with these weights and measures, I think it will be readily admitted that with an article impalpable in its character, the reasons are emphasized an hundred fold, as in the case of electricity. Parliament in its wisdom has decided that this is advisable. We will take up the Bill and see what we find in it. Starting, out we will ask ourselves the question, what constitutes a measure of electricity? What enters into the measure? To my mind there are four questions to be considered: First of all, the insulation of the consumer's wires, the voltage, the limitation or variation of the voltage, the accuracy of the apparatus itself, and the illumination of the lamps, if that illumination is a part of the contract? We simply have power for the testing of lamps for illuminating power, but it strikes me that companies at the present time are not in a position to say that they will give sixteen candle power illumination in a lamp, at least they cannot maintain it, because we know very well after a very short period the lamp deteriorates. Now, taking the first of these propositions, that is, the insulation of the wires, as I said before, that is not very clearly dealt with in the Bill, but in the regulations that we propose arranging for carrying out this work we will endeavor to construe the clause to mean that and provide for it I think that is a very reasonable provision. We had prepared a Bill with four per cent. as the limitation of variation allowed, but Parliament again in its wisdom has decided that is too much A gentleman, a Senator who was interested in electric lighting, and who no doubt had been thoroughly primed by the local company which he represented, when this clause was reached, moved that eight per cent. be made the allowable variation. This is out of the question altogether; that would give you sixteen volts or more on a 120-volt system and eight volts on a 50-volt system. Another very learned electrician who occupies a prominent place in the Senate, told the other gentlemen that they failed to grasp the intention of the Bill, and he moved that it be reduced to three per cent., and he carried his point, so that the Department is clearly not chargeable with this reduction in the percentage. I may say that we had a good deal to contend against in getting this Bill through—215 members and between 80 and 90 Senators. We will have electricians in Parliament as well as out in a very short time. (Laughter.) I am afraid in operating the fifty-volt system the three per cent. will cramp them. It only allows them one and one-half per cent. as the stated voltage That possibly will be a rather narrow limit. A drop of one volt does not materially lessen the light of a fifty-volt system, but it will go half a volt further if there is a want of prompt regulation in the machine, so while three per cent. may be somewhat cramped, you cannot afford to exceed it much, otherwise the consumer will not be guaranteed to be getting good light. We will take up next the meters (clause 13). It is not compulsory, it is at the option of the consumer."

Mr. Campbell—"Is it at the option of the consumer whether the meter is on or not? Is it at their option to have one on?"

Mr. Higman—"Yes. It is a question whether the meter system after all will not be the more profitable one, and I do not think the companies need concern themselves very much about that. They rent the meters and the consumer will pay the rent of the meter."

Mr. Wright—"Have we to put in a meter if the consumer says so and get no remuneration for it?"

Mr. Higman—"I am not quite sure but what there is a clause providing for that. I think they can charge the rent for the meter. We have constructed the Bill along the line of the Gas Companies' Act, and have complied with that as far as we can without

encroaching on the electric light. (Reads clause 15.) That clause I hope meets with the approval of the General Electric Company. It was made expressly for them. (Reads clauses 22, 23 and sub-sections, and 28.) That will place the going into operation of the Act about the 1st of March. It is not intended to attempt any more than seven or eight places at the start. Those will probably be London, Hamilton, Toronto, Ottawa, Montreal, Quebec, St. John, and Halifax. We are in hopes in the interval of six months we can get these into shape and verify meters in these places.

"With regard to sub-section A in the last clause, if the companies undertake to provide absolutely a stated candle power, then I presume that it is a part of the meter work."

Mr. Wright—"The Government have not yet decided the number of watts for a 2,000 candle-power lamp."

Mr. Higman—"No. The Department has not taken any action, and probably will not until this Association comes to us and says, 'We want a standard for arc lighting.' When that day arrives we shall be glad to take it up. While I should very much like to see some arrangement whereby contracts with municipalities might be facilitated, I am rather doubtful if this arrangement of energy, the number of watts as a standard, is a proper one. That standard eliminates altogether the lamp and the carbons, two very important factors in arc lighting. That is my view; but it is quite possible that in delivering the 450 watts to the lamp the company's contract would end there. They might get a very cheap lamp with a very poor carbon, and get poor light, but they would perform their part of the contract and there it would end. I do not think, therefore, it is a very good standard. There is perhaps one other subject I can touch upon. (Reads from same clause.) It is the intention for several reasons to employ such machinery as the Department has already in operation. The gas inspectors for the most part are very intelligent men, and they are well practiced in those tests. The gas test, as you may very well know, is a very delicate thing after all. The test for ammonia and other things requires intelligence and skill on the part of the operator, and I am not without hope that these men will be able to learn how to test the electric meters. It is not necessary they should be learned electricians, but I think they can be got into shape to do the work, and thus lessen the burden on the companies and the consumers, because the consumer is the party who will ultimately pay all the expense."

Mr. Wright read clause 4.

Mr. Higman—"I think you have already done so. I think in most companies they have declared the voltage at which they are working."

Mr. Brown—"I think this is a very important point for those who are using the alternating current. For instance, we use the fifty-volt transformer, and supplying a man from that transformer, the variation in transformer alone is two and a half volts. We have another drop of two per cent. generally on fifty-volt circuits leading into the building, which would make a variation of six per cent. If the Government insists on us regulating within three per cent., we cannot do it, and we will simply have to shut our plants down."

Mr. Higman—"But you know already that the drop will be so much, so you can make an allowance for it."

Mr Brown—"But you cannot very well state that. Using a large transformer, a man might not use very many lights or might use a lot of them. They will vary as high as five and six volts on these large transformers. You cannot give a man within three per cent., no matter how perfect the regulation in the central station may be."

Mr. Thomson.—"The ordinary transformer to-day will vary from two per cent. to two and a half per cent. between small load and full load. In a transformer alone there is a greater loss than the Government will allow."

Mr. Higman.—"At the present time you undertake to deliver 50 volts at the consumer's terminal, or 52 volts. I do not care what it is, but you do state it in your contracts."

Mr. Thomson.—"Suppose there were two houses—one man in one street would use five lights, and the next man would use 55 lights off the transformer; between those two there is a drop in the transformer of two and a half to five volts without counting the wiring at all."

Mr. Higman—"You cannot afford to have a very wide variation on the 50-volt system, or you are not going to have a very satisfactory lamp."

Mr. Thomson.—"I believe it is impossible to get a transformer that will give you 90 or 95 per cent. of efficiency with less than that drop in the transformer. If you decrease the efficiency of the transformer you might get the result of that drop, bnt the object now is to keep the transformer with very high efficiency. As to the wiring, you cannot wire an ordinary building at one per cent."

Mr. Higman.—"Take the voltage at the terminals, there would be a loss at any rate, I suppose."

Mr. Brown.—"I think they ought to give us an allowance of six per cent. on any voltage."

Mr. Thomson.—"I do not think there is a central station in the country to-day that does not vary more than six per cent.—ten to fifteen per cent. very often."

Mr. Higman.—"If it is found to be unworkable we can see about that. I hope next year, when the convention meets again, some progress will have been made in that direction."

A paper was then read by John Langton, Toronto, on the "Possible reduction of station plant on small electric railways by multiple series control of motors."

At half-past four the members proceeded to take cars to the Back River (Sault au Recollet), on the invitation of the Montreal Park and Island Railway. On arriving at the Back River the party spent a short time in viewing the scenery of the river, and then repaired to Peloquin's hotel, where an excellent dinner, well served, was partaken of. After the usual loyal toasts, the chairman, J. J. Wright, proposed "Our Sister Societies," which was responded to by Mr. Francisco, on behalf of the Electric Light Association of the United States, and by Mr. Lockwood for the American Association of Electrical Engineers.

The toast of the "Montreal Park and Island Railway" was replied to by Mr. Marples, of that company, and the "Canadian Association of Stationary Engineers" was responded to by Mr. Wickens. Mr. McFarlane was also toasted, and the company separated at an early hour, well pleased with the entertainment.

LAST DAY.

It having been explained that Mr. Galt was prevented by sickness from being present to read his paper on "Better regulation at central light and power stations by means of fly wheel accumulators of improved construction," the chairman asked for expressions of opinion on the subject.

Mr. Breithaupt said: "This paper of Mr. Galt's is a very interesting production, and a scientific production to a large extent. We have all recognized the difficulty we have encountered with fly wheels. While I have not had the time to look over Mr. Galt's paper very much in detail, in conversation with Mr Galt some time ago, I recognized the principles he means to apply to this construction of the fly wheel. He applies the tension on the rim of the fly wheel in a straight instead of in a bending position, as it is at present in the spokes To go into a detailed discussion of the paper it would have to be read up very carefully. I think it is a very able production, and I have very much pleasure in moving a hearty vote of thanks to Mr. Galt for his paper."

Mr Sperry—"Before that motion is seconded and put through, I would like to say one word. I read the paper coming up on the train last night, and I want to agree with the previous speaker that it is a very ably prepared paper indeed, and it is a subject that is attracting a great deal of attention at the present time, as we all know. In looking at the cuts (Fig. 7), it might be thought that in the spokes put in there are some of them tongued, but I do not understand that is the case. It seems each spoke, A and A^1, as it goes down from the rim, presses upon the hub in a spiral way, passes around on the outside and goes back to the rim. It makes it a very ingenious arrangement, because each spoke not only forms a tangential tension there, but forms a lateral brace. This is the first time Table 1 has been published, I think, and it is certainly a very valuable addition to the designer's tables. At a glance it will give you what you want. I am glad this paper has been produced, and I have taken much pleasure in reading it myself."

Mr. Wickens—"There are so many fly-wheel accidents that the paper to my mind, on that ground alone, is most valuable. As the use of engines in this line has increased, the manufacturers have begun to make a fly-wheel pulley with a very wide face to get the driving surface for belting, etc., they required, possibly sacrificing the strength of the rim a bit. The article very plainly shows what effect that trouble has. Some years ago we hardly ever heard of a fly-wheel accident; we did not have the rim we have to-day. At the present time the whole tendency is to get plenty of energy stored in the rim of a wheel, but from the fact that we are spreading our wheel rims out so far we have an inherent weakness there that should be overcome some way. The paper is very valuable on the lines suggested. The requirement of to-day is a fly-wheel with a speed that is safe. Recent fly-wheel accidents have nearly all occurred in conjunction with other accidents. The engines were going above their normal speed, and of course in building a wheel the idea is to make one that is practically safe at a suitable speed and

will keep the cost down I think if the ideas in the paper are followed out, it is highly valuable. I take much pleasure in seconding the motion of thanks " Carried.

Mr. Galt's paper is printed elsewhere.

The next paper was by F. J. Schwartz, of the Bell Telephone Co., on "Telephone Cables, their Construction and Maintenance," and this was followed by a paper on "Duplex Telephony," by T. R Rosebrugh, Toronto

After discussion on these subjects, Mr. Medbury, seconded by Mr Higman, extended an invitation to hold the next convention at Ottawa.

Mr Taylor extended a similar invitation on behalf of Peterboro'

On being put to vote, it was decided to hold the next convention at Ottawa.

On behalf of the firm of Ahearn & Soper, Mr. Medbury extended a cordial invitation to members of the association to visit Ottawa after the close of the convention.

The secretary was voted $25 as expenses in attending the convention.

The election of officers was then proceeded with and resulted as follows —

President, K. J. Dunstan, Toronto; 1st vice-president, A. B Smith, Toronto; 2d vice-president, C. B. Powell, Ottawa; secretreasurer, C. H. Mortimer, Toronto Executive—George Black, E. C Breithaupt, L. B. McFarlane, T. R. Rosebrugh, John Yule, O Higman, J. W. Taylor, D. A. Starr, J J. Wright and J. A. Kammerer.

The last paper was by Elmer A Sperry, on "Electric Brakes," which was illustrated by photographs.

After votes of thanks to the various companies and individuals who had extended courtesies to the association, the convention was declared closed.

Upon the invitation kindly extended through Mr. Carroll by the Eugene Phillips' Electrical Works, the members assembled at the Queen's Hotel, where cabs were provided for a trip around Mount Royal, which was greatly enjoyed by the company. Previous to the ascent of the mountain, they went to inspect the new power house of the Montreal street railway, upon the invitation of Mr. Cunningham, the manager The convention thus closed very pleasantly.

Electrical Department.

ELECTROLYSIS.

BY JAS. A. BAYLIS.*

"Electrolysis" has been announced as the subject of my paper, but it is too comprehensive a term to be applied to it, as it is to the electrolytic corrosion of underground pipes and electrical conductors by stray earth currents, that I wish to confine my remarks.

During the last year or two the attention of the electrical fraternity, and the public generally, has been frequently and forcibly directed to this subject, and several interesting and valuable articles and papers have appeared in the columns of the electrical press, or have been read before electrical societies. Up to the present time, however, no paper on this important matter has been presented to our association, and I believe that a thorough discussion of the subject at this meeting will be productive of much good to all interested; if my paper (for which I do not claim much originality) serves as a basis for such discussion, it will have well served its purpose. In preparing it, I have freely consulted the transactions of the various societies and the columns of the technical press, and must acknowledge the great aid they have been to me in so doing. This paper, therefore, is more a resume of what has been done by others in this field, than the result of personal experience.

One of the first places to suffer from the evil effects of stray earth currents was Boston, Mass. Almost three years ago the New England Telephone and Telegraph Co. found that the insulation of some of their underground cables had broken down; upon investigating, it was discovered that the lead sheathing had been eaten through in spots in some of the manholes. The matter was carefully looked into, and it was proved beyond a doubt that the current from the rail side of the street railway circuit had leaked on to the sheathing of the cables at various points, and leaving the cables at others, had, at the points of leaving the lead, eaten it away to such an extent as to allow water to penetrate to the core, thus destroying the insulation of the wires.

It was soon found that the destruction of the telephone cables was but an item of the damage being done by these stray currents; water and gas pipes were being eaten through in a number of towns in which single trolley street railways were being operated. After careful experiment it was shown that only where the current left the pipes to pass to earth (*i.e.*, where pipes were electro-positive to the earth) was any damage being done. The explanation given, and the one generally accepted as correct, was that electricity passing through a conducting liquid from the anode to the cathode, decomposes the liquid, and in the case of water, which contains enough foreign matter to make it a conductor, the hydrogen is carried, as it were, and liberated at the cathode, while the oxygen is set free at the anode, which, if it be of an easily oxidizable material, will soon be attacked, nascent oxygen being a very active agent.

The truth of this has lately been questioned in a most interesting and valuable paper on this subject by Prof. D. C. Jackson, read before the Western Society of Engineers, July 11th, 1894. After a series of careful experiments, Prof. Jackson came to the conclusion that the oxidation of the metal as before mentioned played an unimportant part in the destruction of the pipes, and that the corrosive action was due entirely to the electrolysis of the substances held in solution in the water of the soils. The gravity of the corrosion of the pipe depends on the amount of current flowing from a given area and the nature of the salts in the soil.

What happens in the case of buried pipes is this: the current which has leaked from the rails passes on to the pipes, and will leave them and flow to earth at points from which the resistance of the earth circuit to the power house is less than by the metallic one. The soil of cities contains more or less moisture holding in solution chemicals, which, when their components are set free, are of a more or less corrosive nature.

To decompose acidulated water between two platinum electrodes, an E.M.F. of about 1·5 volts is necessary; with lead plates a smaller voltage; and with iron and zinc still less, as the affinity of the metals enters into the reaction. Metals buried in moist earth containing impurities may be about at the point of corrosion, a very slight potential difference being enough to set up marked action. This accounts for the destruction of pipe where only a fraction of a volt P.D. was found between them and the surrounding earth; because the P.D. is under one volt is no surety that action will not take place, not so rapidly or violently of course, but just as surely.

What forces the current to leave the rails and pass to the earth? Undoubtedly because of the too high resistance of the rail circuit, due to imperfect bonding; either the bonds are too small, or, what is more likely, the contacts between the rails and the bonds are not good. Sometimes the rails are connected to the water pipes of a town; if this is done care must be taken to have the water mains connected to the dynamo at the power house, otherwise if the negative pole of the dynamo be grounded or connected to the track, a path of low resistance has been provided for the current to get on to the pipes, but to return to the dynamo it must pass through the earth, and damage is sure to follow.

Very many remedies have been suggested and tried. Here are some of them.

1st. Grounding the positive pole of the dynamo and putting the negative to line.

This only has the effect of changing the location of the district in which the pipes are positive to the earth from the immediate vicinity of the power house to more distant points, and while the action is not so violent, it is spread over a much larger area and the trouble is much more difficult to deal with.

2nd. Breaking the metallic continuity of the pipes and cables has been suggested.

This is impracticable, of course, not only because of the enormous expense of changing all the pipes at present in the ground, but from the fact that current would leave one section of pipe, pass to earth, and back on to the next section.

3rd. Frequent reversals of the polarity of the street railway currents.

* A paper read before the Canadian Electrical Association

This would only retard the action, not stop it altogether. Various other more or less impracticable remedies have been proposed, but it will be unnecessary to notice them.

The only sure cure for this trouble, as far as we know at present, is in the adoption of some other street railway system than that of the single trolley with track return: such as a double trolley system, storage batteries, or alternating currents, if a practical motor can be constructed. A method of street railway construction was described by Mr. W. Nelson Smith in the *Street Railway Gazette* of Feb. 17, '94, which does away with the track return, being practically a double trolley road, operated under the three-wire system, using the earth and rails as a neutral. Another system was described by Mr. Nelson W. Perry in the *Engineering Magazine* for March, '94. Many, if not all, of the proposed underground conduit systems would have as an additional recommendation freedom from attendant electrolytic effects.

The discussion of the merits or demerits of these various systems, their practicability or impracticability, is outside the province of this paper; suffice it to say that there seems to be more than one way of operating street cars, without destroying pipes, &c., already under ground.

Nevertheless, the fact remains that there are very many single trolley roads in operation in this country, and that something should be done to protect the pipes of the municipalities under whose franchises the street railway companies operate.

Absolute protection, as far as is known, it is impossible to have, but to ensure the greatest freedom from destructive action, the track circuit must be of the lowest possible resistance. This can only be accomplished by the best of bonding and frequent cross connections of rails. Electrically welded rails should be of great service in this connection. The rail circuit should be reinforced by overhead returns connected to the rails at intervals, as is done with the trolley and feeder wires. The negative pole of the dynamo should be grounded, and the various systems of underground pipes connected to it by conductors of large carrying capacity.

These are the principal safeguards that can be adopted.

The telephone companies having underground wires have been among the sufferers from the electrolytic corrosion of the lead of their cables, and a brief description of the method used in the United States for their protection may be of interest.

A map of the underground conduits and manholes is made, and on it are marked the differences of potential between the cables in the manholes and the earth, also the direction of the current, whether to or from the cables. In this way the "danger district," or section where the cables are positive to the earth, may be seen at a glance. In this district the sheathings of the cables are carefully connected together by large wire, and a heavy wire (or wires) is run from the negative pole of the dynamo, which is to ground, to the nearest manhole in the danger district, and if the current is of great volume, to several of the manholes. As far as I know, in every case, this has changed the direction of the current, causing it to flow from the earth to the cables, thus giving adequate protection in an inexpensive way. Unfortunately all pipes cannot be protected to the same extent in the same way, and the responsibility of doing proper track construction rests with the street railway companies.

Finally, because in a town there may be but small differences of potential between pipes and the surrounding earth, and decomposition of them does not set in as soon as the street railway current is turned on, we should not be deceived into a feeling of false security, for though the destructive action may be slow in coming, come it will, none the less surely.

Electric Flashes.

THERE is telephone connection now between New Denver and Silverton, B.C.

TELEPHONE connection is now being laid between St. Stephen, N.B., and Eastport.

THE electric light company at Knowlton, Que., is arranging to have more power available.

THE project to light Summerside, P.E.I., by electricity was voted down by the ratepayers.

BOOTH & SON, of Odessa, Ont., have a proposition for supplying the village with electric light.

STRATFORD, Ont., city council proposes to purchase an electric light plant to be operated by the city.

A JOINT stock company is being formed in Windsor, Ont., to manufacture signals for electric railways.

SMITH'S FALLS, Ont., is now being fitted up by the Bell Telephone Co with an electric fire alarm system.

ARTHUR KNOX, a five-year old boy, was run down and instantly killed by a trolley car in Toronto last month.

THE Montreal Park & Island Railway Co. is now in occupation of its new workshops at the Exhibition grounds.

THE Berlin and Waterloo Street Railway is being relaid in some places with a view to its conversion into an electric road.

A LARGE brick building is being built at a cost of $15,000 in St. Roch, Que., to receive the Montmorency Electric Power Co.'s machinery.

THE Montreal Street Railway Company have ordered a boiler for their motor shop, to be made by the Jenckes Machine Company, Sherbrooke, Que.

IT is stated that preparations are being made to start construction work on the Canadian tunnel of the Cataract Construction Company at Niagara Falls.

JOHN W. THOMPSON, late manager of the Reliance Electric Mnfg. Co., of Waterford, Ont., has bought the estate from the assignee, and will start the business anew.

THE Hamilton & Dundas Railway Company have decided to run with the "dummy" steam engine instead of electricity till 1896, when the lease to Mr. Myles expires.

AT a meeting of the Montreal Island Belt Line Railway Co. this month, O. M Auge was elected president, Wm Clendinneng vice-president, and A Prieur secretary.

THE estate of T. W. Ness & Co., electrical appliance manufacturers, Montreal, was last month bought up by Mr. Rankin, a member of the late firm, at 30 cents on the dollar.

THE Central Telephone Co. are applying for incorporation. They will operate a line along the route of the Nova Scotia Central Railway from Bridgewater to New Germany.

THE Chambers' Electric Light Co., Truro, N.S., will this month put in a 500-light dynamo, and they have lately remodelled their switch board and put in new regulating appliances.

THE Miramichi Telephone Co., of Chatham, N.B., have just completed changing their system from the Law to the magneto system. Geo. M. Macdonald is chief electrician for the company.

THE ratepayers of Weston have refused to agree to the $5,000 bonus to the Toronto and Suburban Railway Company, and the manager of the company says the extension shall not be made unless the bonus is granted.

A MAN riding a bicycle in Peterboro' one day last month owes his escape from death to a fender In endeavoring to escape from a swiftly moving wagon, he ran right into a trolley car, but both machine and rider were picked up by the car fender and saved

THE St John Electric Railway Co. have commenced the construction of the main line between Indiantown and Duke street, and they hope to have the entire system completed by early next month.

THE Westminster, B.C., Telephone Co. have laid a second cable across the Fraser River to connect New Westminster and Vancouver with Ladner's Landing, replacing the cable swept away by floods last spring.

MISS ELIZABETH EDGAR, of Plainfield, N J., was the victim of a terrible accident in Queen Victoria Park last month, being struck down and instantly killed by a trolley car on the Niagara Falls Park and River Railroad.

THE Electric Chronometer Company, Toronto, is applying for incorporation. Capital stock, $100,000. They will manufacture chronometers and other time indicators, supplying correct time by electric means from central clocks.

THE St Henry Chemical Co. have finished the construction of two large dams across Fall river, near Waverly, N.S., and will utilize a waterfall there for power to drive electric cars in Halifax, besides several factories in Waverly.

THE Petrolia, Ont., Electric Light, Heat and Power Co. are applying for incorporation. The proposition is to pump oil by electricity from the wells from a central station, and also to light the town by electricity. Capital $50,000.

THE Montreal Belt Line Railway now have the necessary half a million dollars' worth of subscribed stock, and the work of construction will be commenced within a month. The work of surveying round the island is already completed.

OTTAWA is the latest city whose inhabitants want the power to ride on Sundays on the electric railway, if they choose to do so. Petitions are being circulated, especially among church people, with a view to requesting the Street Railway Company to institute limited service on Sunday.

THE Cataract Power Co., Hamilton, is applying for incorporation. The applicants are W. H. Glassco, W. Southam, R Fuller, W A Wood, J. W. Hendrie, W. W. Osborne, and John Patterson, all of Hamilton The company's object is to bring power from Niagara Falls to the city of Hamilton

SIR Frank Smith and Col. Mason were driving in Toronto one day last month, when their horses became frightened at a trolley car and dashed into it, and both gentlemen were thrown to the ground. Col. Mason received little injury, but Sir Frank Smith had two ribs broken. He is recovering satisfactorily.

THE annual meeting of the Great North-western Telegraph Co was held in Toronto last month, and the old officers were re-elected as follows: President and general manager, H. P Dwight, Toronto; vice-president, Adam Brown, Hamilton; secretary and auditor, George D. Perry; and treasurer, Arthur Cox.

MR. LEMAY, of Sherbrooke, offers to supply Magog, Que., with electric lighting, incandescent 16 c.p. lights at $6, 32 c.p. at $10 per year, and arc lights, if wished for, at $55 per light per annum. The plant to be in operation within a year from date of contract, and Mr. Lemay to have full rights for the term of five years.

A MOTOR car in Toronto the other day met with a peculiar accident, and one which might have been followed by disastrous results. It was running over Gerrard street bridge, crossing Don river, when it suddenly left the rails and dashed into the fencing of the bridge. This gave way. The car was precipitated over the edge, but luckily the hind wheels caught on the stringers of the bridge and remained suspended till help arrived. The few passengers on board were uninjured.

THE Sherbrooke, Que., Telephone Co. propose to complete a number of trunk lines to Sherbrooke from Compton, Ayer's Flat, Stanstead, East Hatley and Dixville. Some of these are already in course of construction, and all will probably be completed before winter. They have also arranged to supply telephone service for the Boston and Maine Railway at stations along their line in Canada for the next five years. The directors have decided to pay in the future a 6 per cent. dividend.

A DEVICE to render false fire alarms impossible was shown in Montreal lately The invention is H. Trudel's, and is known as the "Fire Alarm Hut" The hut resembles the police patrol box, and is opened by simply turning a handle; the alarm, however, cannot be reached till the door is shut, and the moment it is rung the door becomes automatically locked, the ringer becoming a prisoner till rescued by the firemen. We can quite understand the false alarm fiend not caring to tackle this new invention, but might not persons having legitimate reasons for calling the fire brigade abstain from rendering themselves liable to incarceration also?

THE Bell Telephone Company have purchased the site at Notre Dame and St. John streets, Montreal, for $55,000, and will erect a fine structure thereon. The company's new offices at Ottawa are ready for occupation.

THE Merchants' Telephone Co. of Montreal is to be in operation within a month or five weeks. The capital stock of the company was exhausted in partly putting in the necessary equipment, but the directors lent the amount required to complete this work.

THE Hamilton, Waterdown and Guelph Electric Railway Co. is asking Hamilton city council for a bonus of $125,000. The estimated cost of the road is $300,000, and its promoters are J. I. Flatt, M.P.P., W. O. Sealey, of Waterdown, and W. P Howland, Toronto.

THE receipts of the Toronto Street Railway last month were the largest in the history of the company, amounting to $104,152, against $92,745 for the corresponding month last year. The Exhibition traffic accounted for the increase The city's percentage of the receipts was $8,332.

ST. THOMAS, Ont., Street Railway has been sold to the syndicate which controls the Montreal, London, Toronto and Cleveland street railway systems, and the service will be extended and converted into an electric line. It is proposed to extend the line later on to Port Stanley.

THE Montmagny Manufacturing and Electric Light Co. have been incorporated, with a capital stock of $10,000. They will manufacture and instal electric light and telephone appliances, etc., and manufacture and deal in lumber. We understand the head office will be at St. Thomas de Montmagny, Que.

HULL, Que., city council have given a contract to Theophile Viau to furnish electric railway and lighting systems for a term of 35 years. The railway scheme also contemplates branches to Aylmer, Gatineau and Ironside. Mr. Viau will form a company to take advantage of this valuable franchise.

A PROCLAMATION has been published to the effect that the law which was passed at the last session of the Dominion Government, relating to the electric light inspection, shall come into force April 1st next. The standards and apparatus have been approved, and O. Higman has been appointed chief inspector. Mr. Higman is now engaged in organizing his department.

H. F. DENNIS, electrician for Bennett & Wright, Toronto, has been appointed instructor in electricity for the commercial college of Shaw & Elliott, Toronto. Mr. Dennis is well qualified for the position, having graduated from the Massachusetts Institute of Technology in Boston, and being for eleven years engaged in practical electric work with the Thomson-Houston Company, and other corporations.

THE Montmorency Electric Power Co. will make application at the next session of Quebec Legislature for power to increase its subscribed capital stock and to acquire the ownership or use of any patents or rights with regard to electricity or any other motive or illuminating power, and also to acquire such riparian rights, etc., on streams and lakes in Montmorency, Quebec and Charlevois counties, as may be necessary for the company's purposes. The contract for the four large generators for these works has been taken in hand by the Stanley Electrical Manufacturing Co., of Pittsfield, Mass., for whom M. D. Barr & Co. are Canadian agents. The great water wheels already installed there were built by J. C. Wilson & Co., of Glenora, Ont.

SYDNEY, N.S., has an all night electric service. This, says the *Island Reporter*, is one of the benefits of the wise course of the two competing companies being amalgamated, and now supplying light from the same station The new company have purchased a new engine and boiler to run their plant

THE Packard Lamp Co. (Ltd.), Montreal, has now been incorporated with a total capital stock of $300,000. They manufacture and deal in electrical and other machinery and all kinds of articles connected with the supply of electricity and the use of electric apparatus. The incorporators are W. D. and J W Packard of Warren, O , J. H and H. K. Howry, of Saginaw, Mich., C. C. Paige (manager), Montreal, F. E. Cavanagh, Montreal, Alex. Mackenzie, Toronto ; and T. C. Sims, of Little Current, Ont. It has not yet been decided where the new company will have its headquarters, but in all probability it will be in Montreal or Ottawa. The intention is to absorb the present Packard Lamp Co.'s business, which at present is confined to the manufacture of electric lamps and transformers. The sale of these standard lamps has increased over 30 per cent. during the past year.

TORONTO Fire and Light Committee a few days ago opened tenders for the electric lighting of streets. Hitherto the price charged by the Toronto Electric Light Company has been 29¼ cents per lamp per night, or $109 per lamp per annum. The lowest tenders now sent in were, one from the Toronto Street Railway Company, the price being $83.65 per lamp per year for five years, or $76.66 for twenty-five years; and one from the Toronto Electric Light Company, who offered in the future to supply light at $74.82½ per lamp per annum. The question whether the city will do its own lighting has not yet been finally decided. Meantime a sensation has been caused by the statement that the Toronto Electric Light Co. had been approached by certain aldermen who were soliciting bribes, and the matter is to be investigated before the county judge

Personal.

GEO. MCSHERRY, proprietor of the McSherry Plow Works at Ingersoll, Ont., died on the 30th Sept., at the age of 57. He had been ill for some years.

J. B. MACKAY, who superintended the construction of the Niagara Falls Park and River Railway, was presented the other day with a gold watch from the officers of the company on the occasion of his return to his home in Montreal

LYMAN MOORE, the well-known Hamilton manufacturer, died on the 8th inst. Until his retirement a short time ago, he was manager of the Hamilton glass works. Mr. Moore was for many years president of the Hamilton Street Railway Company.

THOS. R. ALLISON, engineer and machinist to the Chatham, N B., fibre and pulp mills, has severed his connection with that industry, and will be succeeded by Mr. Wilson, late chief engineer of the St. John electric works. Business at the pulp mills is brisk.

W. H. PRICE, travelling passenger agent of the I.C R., while in Halifax the other day, was presented with a gold pin from the Nova Scotia Mining Society in recognition of his courtesy to the members of the society, on their recent convention. The pin bears on it the emblem of the society.

JOHN CONWAY has been appointed superintendent of the Lachine Canal. He has spent most of his life in working on the canal During the enlargement of the canal he began work as a chainman, and before its completion he had been promoted to the position of assistant engineer. Ernest Marceau is chief engineer.

MR. UNSWORTH, chief superintendent of the I.C.R., died at Charlottetown, P E I., last month. He was connected with the G T.R. for several years, but since 1872, when he began construction work on the I.C.R., has been connected with the latter road. He was a member of the Canadian Society of Civil Engineers A widow and five children are left.

FRED W MOUNT, electrician of St. John, N B , Gas & Electric Light Co., committed suicide on the 5th inst. by shooting himself with a revolver. Deceased had been suffering from fits of despondency since an accident which had injured the sight of one of his eyes about a year previously. He was a native of Montreal, and was about 40 years of age He was a clever electrician.

CAPT. GILBERT JOHNSTON, of the steamer "Hero," has been appointed mechanical superintendent for the Richelieu and Ontario Navigation Co. He is well known on the lakes as an intelligent and careful engineer He did his first steamboat work, says the Kingston *News*, as engineer on the steamer "Shickluna," between Chicago and Montreal. After a few seasons he took charge of the steamer "Lake Erie" on the same route. He subsequently took an appointment as mechanical superintendent of the Chicago and Montreal Forwarding Company. His next charge was at Deseronto, where he looked after the engine department of the Rathbun Company. Upon leaving there his services were secured by the Collins Bay Rafting Company, in whose employ he remained for some time. He then secured a more lucrative position as foreman in McEwen's machine shop, Kingston He then went to the Lake Ontario and Bay of Quinte Steamboat Company, first as engineer on the steamer "Hero," and then as captain. He succeeds P. A. Thompson, who goes to Kingston to replace E. Adams, as boiler inspector. Captain Johnston's headquarters will be at Sorel, and he will have 27 steamers besides the machine shops, employing 200 men under his care. Captain W. Bloomfield has taken charge of the steamer "Hero" in place of Captain G. Johnston.

ASSOCIATION OF ARCHITECTS.

The annual meeting of the Province of Quebec Association of Architects was held in Montreal on Thursday and Friday, the 4th and 5th inst. The chief business on Thursday was the election of officers, which resulted as follows:

President, Charles Baillairgé, Que.; 1st vice-president, A. C. Hutchinson, Montreal; 2nd vice-president, A. T. Taylor, Montreal; secretary, J. Venn, Montreal; treasurer, J. Perrault, Montreal. Members of Council—J. Nelson, A. F. Dunlop, A. Raze and L. Z. Gauthier, all of Montreal, and F. X. Berlinguet and J. B. Bertrand, of Quebec. Auditors—W. McL. Wolbank and J. Z. Resther

A fine photographic group of the Montreal members of the association was presented to the Quebec section.

In the afternoon, Chas. Baillairgé read a paper on "Foundations in Deep and Unreliable Soils," in which, after referring to some notable instances of the instability of buildings constructed upon sandy or other unsuitable soils, the author spoke of the necessity in Canada for a school of architecture, where aspirants could receive proper instruction in the sounding of soils, etc. It was hard, he thought, to see how, while an engineer would never attempt to drive a pile or sink a caisson without sounding the soil he had to build on, an architect could consider himself less liable to the danger of unequal settlement. It was not settlement that was to be guarded against, but inequality of settlement in the different portions of a foundation.

A. T. Taylor also read an interesting paper on "The City of the Future."

The evening was taken up with a conversazione at the Art Gallery and opening of an architectural exhibition.

Friday was spent in visiting some of Montreal's objects of interest, including the new Erskine Church, designed by A C Hutchison.

IMPROVED REGULATION BY FLYWHEEL ACCUMULATORS.

BY JOHN GALT, C.E. AND M.E.

The object of this paper is to indicate a simple means whereby considerable energy may be efficiently stored and restored to advantage for central power station purposes.

This at once suggests that a suitable accumulator capable of operating also as a regulator must be introduced.

Energy, as you all know, is only another expression for accumulated work, which may be done either by raising the body a given height, or impressing upon it a given velocity, the first example being the simplest idea of what is meant by the elementary measure of work.

When force acts upon a free body it will of course set it in motion, notwithstanding its inertia, which presents a resistance to be overcome. Thus work is also done in impressing upon a body velocity either linear or circular, one of transition or rotation.

The inertia due to mass is ever present, therefore work can be accumulated or stored up in a rotating wheel as surely as it can be in the ram of a pile driver, the bullet or ball from a gun, or the ponderous head of a steam hammer.

A heavy rotating body as a fly wheel of an engine is simply a reservoir into which the work of the engine can be poured just as water into a reservoir, or some mechanically constructed accumulator, there to be restored when occasion demands.

The following equation gives the estimate of work stored up in a body when moving or rotating with a given velocity.

When a velocity V is impressed on a body of weight W, the work done or stored up

$$= \frac{WV^2}{2g}$$

From this expression we can conclude that the work stored up in the separate parts of a body moving with any given velocity depends upon the square of the distance of each part from the revolving centre of axis of rotation.

For example, one pound or one ton weight 3 feet from the axis of

rotation has nine times as much work stored up as the same weight at a distance of 1 foot, provided the angular velocity is the same in both cases.

There are very many examples in the arts of accumulating work by simple mechanical means, similar in principle to the one which I now propose for consideration.

The flywheel press which is used for cutting and punching material or stamping coin consists merely in the application of a revolving lever or wheel weighted at the ends, or the heavy revolving flywheel in a shearing or punching machine has the same principle applied for accumulating energy to assist in carrying the prime mover over its hardest work.

Take the case of the tiny sewing machine, whether driven by hand or foot When the wheel is turned rapidly it runs steadily and uniformly, notwithstanding that the driving force is variable; this exhibits largely the function of a flywheel for ordinary purposes.

From what I have already stated a good deal may easily be learned about the nature of a flywheel.

Suppose two wheels exactly alike attached to each other on the same shaft, so as to make practically one wheel of double the weight, then the work stored up for any given speed per minute is doubled, thus showing the influence of weight alone.

Let, however, the speed be doubled by increasing the number of revolutions in a given time, or by increasing the diameter of wheel, then the work stored up is four times as great.

This latter case emphasizes the great importance of velocity.

Reverting to the original formula representing the energy stored in flywheel, viz.: $E = \frac{WV^2}{2g}$ then by differentiating $\Delta E = \frac{WV}{g} \Delta V$ or $\frac{g}{WV^2} \Delta E = \frac{\Delta V}{V}$ which is the fluctuation of velocity, and it is the function of the flywheel to keep this down within small limits. This fluctuation may arise either from variations in the effort exerted by the prime mover or from variations in the load or resistance, or it may arise from both these causes combined.

When one flywheel is used it should be placed in as direct connection as possible with that part of the mechanism where the greatest amount of fluctuation originates, but when it originates at two or more points it is best to have a flywhel connected to each.

We can readily see from the original formula that a flywheel running with a considerable rim velocity can store a very considerable amount of energy.

Take for example a wheel having a rim velocity of 75 feet per second, and weighing, say 20 tons:

$$\text{Energy of rim} = \frac{20 \times 75^2}{2g} = 1747 \text{ foot tons}$$

$$\text{Expressed in horse power minutes } \frac{1747 \times 2240}{33.000} = 118.6\,P$$

$$\text{Or direct from original equation } \frac{WV^2}{948.8} = 118.6 \cdot P. \text{ minutes}$$

This represents the ordinary safe speed of the present best design of cast iron flywheels Now if improved flywheel construction will secure an increase of speed say to 150 or 300 feet per second, the energy stored would of course be four times and sixteen times greater, viz., 500 to 2,000 horse-power minutes respectively, as against, say 120 horse, with a similar proportionate increase of energy available and ready to be restored for regulating purposes.

Column 2 of table I. shows the total amount of energy stored for different rim velocities for each ton weight of rim.

The energy is expressed as horse-power minutes instead of foot tons or foot pounds—in other words, if the energy of the flywheel were all used up in one minute the horse power given out would be the number there stated.

Flywheels of the ordinary type in use occasionally fly to pieces without giving the slightest warning, making an utter wreck of the station, besides being very often accompanied by loss of life.

Of late years these accidents have become very numerous, and the reason is simply this, that prime movers and flywheels are called upon now to perform much harder duty than formerly, and any one who has studied the present requirements, especially for central power station work, must be more than convinced that some improvement in the line I am pointing out would be of immense advantage. Little or no improvement in the design and construction of flywheels has taken place since the introduction of the steam engine, and this is all the more remarkable when we consider the many improvements which have taken place in almost every other direction and detail of mechanical science.

The consensus of opinion of both mechanical and electrical engineers and experts everywhere may be summed up in the statement by Dr. Edward Hopkinson, of London, England, in his late paper on Electrical Railways, viz:

"If an efficient accumulator, capable of working as a regulator, could be introduced, it would be possible to reduce the capacity of a generating plant by at least 35 to 40 per cent., and at the same time considerably increase its efficiency. Such an accumulator I venture to suggest is to be found in better wheel construction. With any electric railway on which there are a number of cars it always happens that at frequent close intervals of time the load is very much beyond the average power required."

The generating plant at the central station must of course be of sufficient capacity to meet the largest demand which may be made on it. Consequently without some source of accumulated energy to fall back upon, the prime movers must be made larger in order to handle with certainty the maximum loads.

Both in Europe and America the subject of improved flywheel construction is now beginning to receive the attention its importance deserves.

The central station of the Union Railroad Company, from which are run all the trolley lines of Providence, R. I., has lately installed cross-compound engines, with direct connected generators on engine shaft, having specially designed flywheels, the main object being the prevention of accidents, which have recently been of frequent occurrence.

Mr Sheldon the engineer, believed that he could make a wheel which would be absolutely indestructible, and prevailed upon the directors to insure themselves against the flywheel epidemic, by building it entirely of wrought iron and steel, with a large margin of safety—no attempt or claim, however, being made to secure better accumulation of energy, and consequent steadier regulation.

Its design and construction will be apparent from the drawings reproduced and illustrated in Fig. 1.

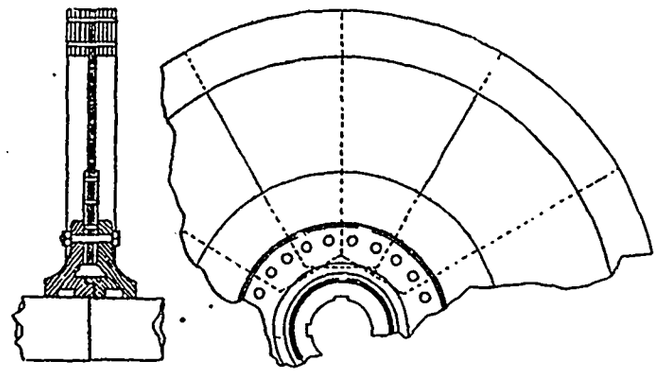

FIG. 1.

The steel rim is attached to a plainsteel disc, which takes the place of arms or spokes, the whole being connected to shaft as shown by means of cast iron hub or nave.

This wheel, which must have cost a very great deal of money, has not been built to act in any better capacity as a regulator than the ordinary cast iron flywheel, and it surprises me that it was not designed and proportioned to operate also as a powerful wheel by merely increasing its rim velocity, even at the expense of a reduced factor of safety, which at 40 is altogether too high for requirements of safety alone, especially when wrought iron and steel is used, and not cast iron, which at the best is a most uncertain metal.

That there is a want for a powerful but light flywheel will be generally admitted.

Some advocate heavy flywheels because of their power, others again condemn them because of their weight.

A powerful flywheel of ordinary design, meaning a heavy flywheel, has placed engineers between the devil and the deep sea.

Now a powerful and light flywheel deriving its power from its high speed should satisfy both sides.

In prosecuting my enquiries I find that already a very good practical solution of this problem has been suggested.

Prof. Sharp, B Sc., Wh. Sc., etc., a distinguished mathematician and engineer, of London, England, has taken up this subject, and actually invented and patented within the last month or so a new method of wheel construction, which appears to exactly fill the bill. This improvement covers the entire ground, and

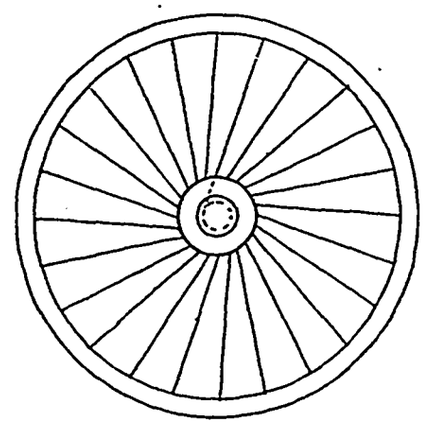

FIG. 2.

strange to say, is applicable to all kinds of wheels from the perambulator and bicycle wheel up to the pulley for power transmission, as well as large flywheels.

Having made this discovery, I at once entered into correspondence with Prof. Sharp, and have his letter of last month (August), stating that he is now arranging to have his new design introduced in some important contracts.

I am much indebted to him for his pamphlet giving a pretty accurate and full description of this new system of wheel construction, together with rules and formula on the "*Theory of the New Flywheel.*"

The principle of this new construction proposed is based upon the use of steel spokes instead of arms or disc, these spokes being tangent and attached respectively to the rim and nave.

This feature of tangent spokes, now so well and favorably known

in bicycle wheel construction, is, it seems to me, one which can be advantageously applied and extended generally to all kinds of wheels, and it is in this direction where mechanical accumulators may be looked for. When any wheel built with radial arms or spokes is at rest, their direction passes through the centre of the hub, but when a driving effort is exerted, the direction at once changes, and instead of passing through the centre of the hub, passes along tangent to a small circle as illustrated in Fig 2.

This action causes continual bending to and fro of the spoke at the point where it leaves the hub and the stresses induced by bending are much greater than those due to the direct tension of the spokes. In fact a wheel with radial spokes is not a rigid structure, for before it can be driven the hub has to be moved through a small circle relative to the rim. If the direction of driving is reversed, the hub must first return to its original relative position and then be displaced an equal amount on the opposite direction before driving can take place. To obviate this injurious action, tangent spokes have been introduced of late into bicycle and other classes of wheel construction, and there is no good reason why this design should not be adopted for wheel construction generally and especially for pulleys and flywheels. These tangent wheels are built with the spokes such that they all permanently touch a certain fixed driving circle. Half of the spokes are inclined in one direction and half in the opposite.

In a wheel constructed with spokes tangent to the driving circle, when the driving effort is exerted, the tension of one half of the spokes is increased and that of the other half diminished.

Theoretically, then, a tangent wheel is much better than a direct or radial spoke wheel, since it approaches more nearly to a rigid structure, as the angle of displacement of the hub relative to the rim being very small and due entirely to the stretch of the spokes caused by tension due to driving effort.

A heavy flywheel which is too large to be cast in one, or two half pieces, is usually built up, the rim being cast in segments and the arms also of cast iron carefully fitted at one end to the nave and at the other to the segments of the rim, or in some cases the arms are cast on as part of the rim segments and only require attaching and fitting to the nave.

The cost of constructing a large flywheel in this way is very great.

Fig. 3 is a section of the rim with spokes attached for a flywheel pulley to be built in segments on the new system.

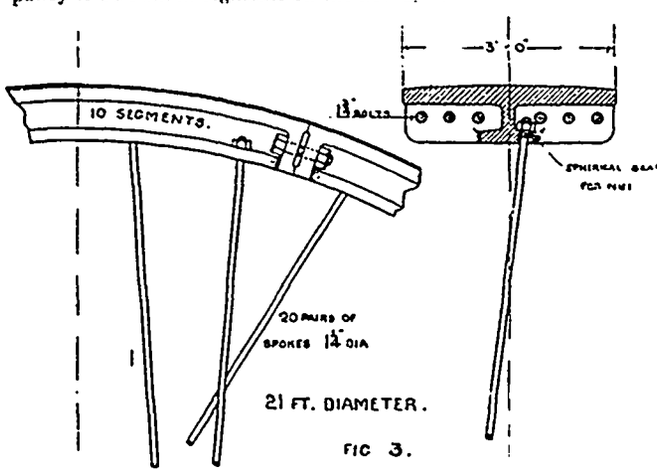

FIG 3.

With ordinary cast iron wheels the speed must not exceed a certain limit, as the centrifugal force due to the rotation produces forces on the rim acting radially outward, these are balanced partly by the tension on the arms and partly by circumferential tension on the rim; these combined forces produce bending on the rim similar to a beam uniformly loaded and fixed at supports, as shown in Fig. 4.

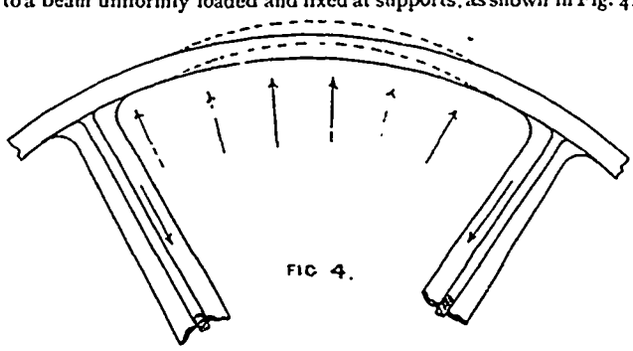

FIG 4.

The exact amount of the stress due to this bending moment is difficult to determine, but that it is very much greater than the circumferential tension on the rim is proved by the fact that a linear speed of rim of 100 feet per second (which is the highest speed allowable for a large flywheel), the circumferential tension on the rim is only ½ ton per square inch, whereas the breaking tensile strength of cast iron is from 10 to 12 tons Thus the stresses on the rim due to bending caused by the pull of the arms at a few points only, must certainly be very great.

In flywheels with numerous steel spokes, Figs. 3 and 8, there is no very great length of rim unsupported, consequently this bending action is almost entirely eliminated, and therefore a much higher speed can be used with safety

In wheels with radial arms the arms or spokes which are straight when the wheel is at rest will each be bent as shown, exaggerated at *a b* (Fig. 5), when the effort is being transmitted from the nave to the rim in the direction indicated by the arrow If the direction of driving be reversed, or if the driving effort be lessened, and the rim overruns the nave the arms will be bent as shown by dotted line at *a b*.

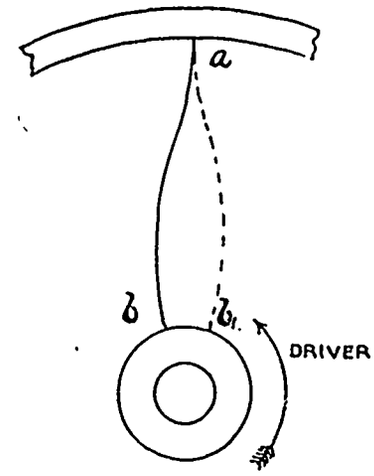

FIG. 5.

It will be seen therefore that radial spokes constitute a slightly flexible coupling between the rim and nave of the wheel, so that the rim may be moving with practically uniform velocity while the fluctuation of velocity of the nave may be considerable, whereas the action of the tangent spokes, being a rigid structure, is entirely different.

In continuing the consideration of this subject further, I will refer almost entirely to Prof. Sharp's system of wheel construction, because I find he has provided for the difficulty of attaching spokes to nave by a simple and efficient method of winding spokes in pairs around the nave in helical friction grooves.

The distinctive features of Prof. Sharp's new system of wheel construction are illustrated in Figs. 6 and 7

The nave or hub of the wheel is attached to the rim by a series of loops of iron or steel, one loop forming a pair of spokes.

Fig. 6 illustrates the elevation of a wheel with 24 spokes in 12 pairs. One loop or pair of spokes is shown thickened.

The ends of spokes are fastened to the rim by means of nuts or nipples in any usual way.

There is absolutely no fastening of the spokes to the nave beyond that due to friction.

The ends of all spokes may lie in one plane, but as the spokes approach the nave they are spread out latterly in a similar manner to that usually seen in bicycle wheel

Fig. 7 is a section through the nave and rim and shows the lateral spread of the spokes; the nave surface may have a single or multiple screw according to the requirements.

The pair of spokes *a*, *a'*, Fig. 8, is shown having an arc of contact with the nave of nearly half a turn, the part of the loop *a*, *a'*, in contact with the nave, is formed spirally so that all ends of the spokes on one side of the middle plane begin contact with the nave at the same distance from the middle, and the other ends leave the nave nearer the centre or middle plane, Fig. 7.

In the wheel illustrated in Figs. 6 and 7 there are twelve pair of spokes, six pair being on each side of the centre or middle plane, so if the parts in contact with the nave lie in grooves, these grooves will form practically a six-threaded screw on the nave surface.

The arc of contact of each pair of spokes with nave may of course be varied. Thus keeping the end *a* fixed in the position shown in Fig. 6, the end *a'* could be taken to the place occupied by a'^{8}.

By making the spokes have a spiral arc of contact with the nave as described above, the positions of all the spokes relative to the nave are exactly similar, and thus the wheel is symmetrical, and the spokes are all of exactly the same length.

This would not be the case if the arcs of contact were circles whose planes were perpendicular to the axis of the wheel, as the middle points of each of the pairs of spokes would then all lie at different distances from the middle plane of the wheel.

The nuts or nipples fastening the spoke ends to the rim being screwed up until the necessary tension is on the spokes, there is ample friction between the spokes and the nave to prevent any relative movement, while the angle at which the spokes leave the rim remains always the same, consequently there is no injurious wrenching action on the rim joints.

The rim joints can therefore give no trouble, however severe the work to be done by the wheel.

In Sharp s wheels the action of the spokes is illustrated in Fig. 10, and shows the relation of the pair of spokes to the nave and rim. When transmitting effort from the nave to the rim, in the direction indicated by the arrow, the pull F^a on the portion *a b* of the pair of spokes is a little greater than the initial pull, while the pull F^d on the portion *d c* is a little less than the initial pull. The difference between F^a and F^d is taken up by the frictional grip of the portion *b c* on the nave. The difference $(F^a - F^d)$ multiplied by *r*, the radius of the hub, gives the twisting moment transmitted per pair of spokes Or the forces F^a and F^d, acting at *a* and *d* respectively, may be resolved into radial and tangential components T^a, R^a, and T^d, R^d respectively. The radial components R^a and R^d have no effect in accelerating or retarding the motion of the rim,

so the resultant force accelerating the rim is $(T_a - T_d)$ per pair of spokes.

Now, in a flywheel, suppose the effort at any instant to fall below the average resistance, as would be the case near the beginning and end of each stroke of the engine, the pull F_d on the portion $d\,c$ would become greater than the pull F_a on portion $a\,b$, and the rim of the flywheel would supply to the nave the momentary deficiency of effort The only effect of this slight variation of stresses on the portions $a\,b$ and $d\,c$ of the spokes is that they are slightly elongated, the elongation being so small that the whole wheel—rim, spokes, and nave—constitutes a practically rigid structure Thus for a variation of stress of 1 ton per square inch, taking E, Young's

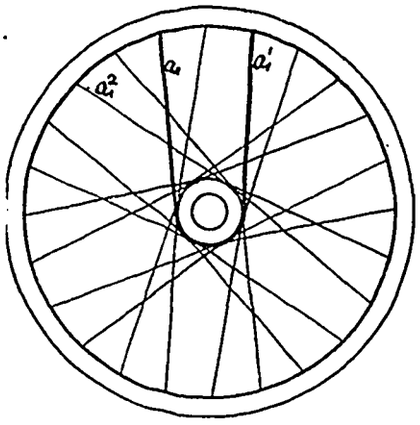

FIG 6.

FIG. 7.

modulus, 10,000 tons per square inch, the spokes will stretch periodically $\frac{1}{10000}$th part of their length In a wheel 20 ft. diameter this periodic stretch of the spokes will be

$$\frac{10 \times 12}{10000} = \cdot 012 \text{ in.}$$

As regards the staunchness of the joints between the rim and spokes, the case is infinitely better than in the radial spoke wheel. Whatever be the stretch of the spokes, they must always touch the nave circle of radius r. Thus the angle at a or d at which the spokes leave the rim remains always the same, and there is consequently no wrenching action on the rim joints.

Fig. 8 shows description of a high speed flywheel according to the new method of construction, Fig. 9 showing enlarged section of rim.

An exactly similar method of construction can be applied to flywheel pulleys where too large to be cast in one piece, as illustrated in Fig. 3; the spokes and nave can be designed in a similar way to fig. 8 with 10-threaded screws.

This cast iron pulley (see Fig. 3) is 21 ft. in dia and has 1¼ in. spokes. The rim is in segments of cast iron and weighs in all 16 tons, nave 1 ton, and spokes ·7 tons; these proportions of course will vary according to the requirements of design for different speeds.

In order to illustrate more pointedly and fully the applications of these new designs let me take first the example of a gas engine working with the Otto cycle, the excess energy of which is very

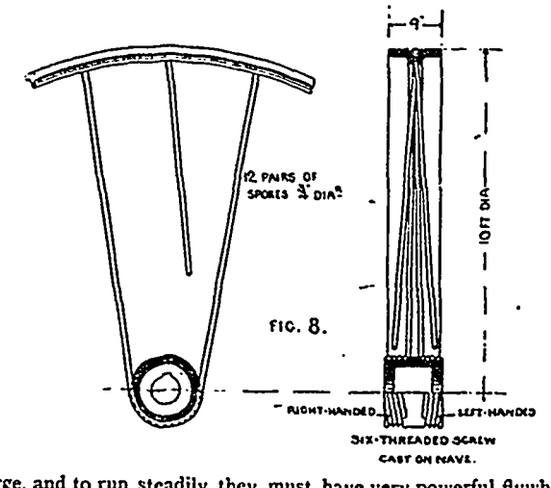

FIG. 8.

large, and to run steadily they must have very powerful flywheels.

For electric lighting purposes a gas engine is sometimes employed to drive a dynamo direct.

As an example, suppose a dynamo to make 240 revolutions per minute or 4 revolutions per second with a flywheel cast in one piece, taking the safe rim velocity to be 80 ft. per second, its diameter would be 6·3 feet

With a wheel built on the new system, the weight of rim being the same as before, if the diameter were increased to 19 ft., the velocity would be trebled, and the fluctuation of velocity would be reduced to one-ninth part of its original value.

The governing of gas engines is obtained almost altogether by cutting out explosions So that with say half load (a necessity which exists often in central lighting stations), an explosion would only take place every three or four revolutions, causing great irregularity of running, unless specially provided against.

What was wanted, therefore, was a gas engine that would give about as good and regular turning movement as the double-acting steam engine, and which might in most cases be easily coupled direct to the dynamo.

By introducing a powerful fly wheel, say of increased weight and speed, a very steady effect could be secured, and if gas engines had always been provided with such flywheel accumulators, there would have been little trouble with belts and unsteadiness of currents from dynamos.

Column 2 of table I. shows the amount of energy stored for different velocities for each ton weight of rim.

Table I. has been carefully calculated and will be found most useful for designing fly wheel accumulators to satisfy given conditions

The available energy per ton weight of rim for a total fluctuation of 10% will be found in column 3. If, however, still closer regulation is desired for special cases, then to provide for a total fluctuation of only 5%, *i.e.*, 2½ per cent. above and 2½% below the average, then column 3 divided by 2 will give the horse-power minutes of energy available, and of course column 4 would require to be just doubled; the remaining columns, however, would remain unaltered.

By way of illustration, let me take another example where the extra power required at the generating station, corresponding with the starting of cars or running on up grades, etc., would be about 50 to 60 horse-power minutes.

From column 3 it will be seen that if a flywheel accumulator be built to run at a speed of 300 feet per second, with a weight of 3 tons in the rim, and with an allowance for a maximum fluctuation of velocity of 5% above and 5% below the average, this will supply the 60 horse power required.

Thus the engine and boiler plant may be of capacity corresponding to the average power required, provided this flywheel accumulator be used.

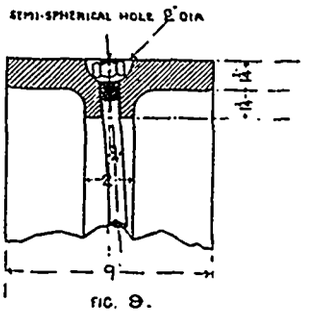

FIG. 9.

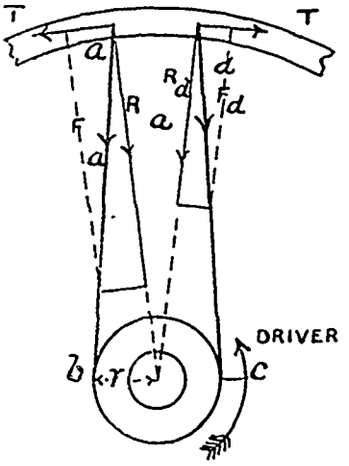

FIG. 10.

Thus when a sudden increase of load occurs the engine will be developing less power than that required at the moment, and the speed will diminish.

During this diminution of speed the flywheel delivers up energy corresponding to the difference between the power required and that developed by the engine at the instant. This diminution of speed goes on until the demand for power at the station falls below that being developed by the engine.

The speed of the engine will now increase slightly, and additional energy will be stored in the flywheel.

Besides reducing the size of the engines and boilers at the station, such an arrangement will allow the engines to work steadily at or near their best maximum capacity, which is most important and advantageous where economy of steam consumption is concerned.

The mechanism of the engine is subjected to far less stress since there is no violent fluctuations of speed, and the governor gear may in many cases be reduced to the simplest type, thus permitting often considerable increase in the number of revolutions per minute of engine, which would assist somewhat in securing the necessary higher rim velocity of flywheel.

In many cases a flywheel might also be attached direct to the dynamo shaft, with some suitable friction interposed between it and dynamo, so that in case of short circuiting the armature of the dynamo might be pulled up while the flywheel continues to revolve, thus merely corresponding to the breaking of the belt in the case of a belt-driven dynamo.

Taking a speed for a dynamo shaft to be 600 revolutions per minute, a wheel 12½ feet in diameter would give the necessary rim velocity of 300 feet per second, and for the requirements of last example give the necessary 60 horse-power minutes of available energy.

From an examination of load curves from several power stations taken from meter readings, the period of time from average to maximum load seldom exceeds one minute, and in average-sized and well-developed railway systems this period is very much reduced, and falls within 15 seconds.

The load curve for example from the Toronto Street Railway power station showed at one time a fairly uniform load line of 2,000 average horse power, the readings being taken, I think, every 15 minutes, and even then the ordinary average was tabulated after all the violent and momentary fluctuations on ampere meters had ceased.

Had the load curves been drawn out to readings of 15 seconds

instead of 15 minutes, the variations would have been clearly marked; as it was, however, I found that within periods of half minutes, more or less, the extra power required varied from 20 to 30 per cent. above the average, viz., from 2,000 to, say, 2,500 horse power. And it would be further apparent to any observant mechanic that the entire machinery in the station from the revolving armature in the generators, down through the mechanism of the engine and its governing gear to the very steam inlet valves of cylinders, and along through steam pipes to the water in boilers, had to accommodate themselves directly to this sudden demand upon them, simply because there was no form of accumulated energy attached to the driving machinery to fall back upon in order to carry it over the momentary maximum load resistance.

The engines in this station are five in number, each of say 500 horse power, of the Armington & Sims design, cross compound with double cast-iron flywheel pulleys, each 8 feet in diameter, and revolving at about 275 revolutions per minute, belted direct to generators for a much higher speed.

For the purpose of comparison it will be sufficiently near the truth to assume that both flywheel pulleys have rims both weighing together about 4 tons, running at 100 feet per second. This, according to table, will give 40 horse-power minutes, and with a total variation of 2½ per cent. above and below the average speed, the total available enery will be 4 horse-power minutes, or a total available energy for road regulating purposes over the entire 5 engines in station of 20 horse power.

This amount is of course entirely inadequate for anything beyond the mere work and the functions of an ordinary flywheel.

You will now appreciate the value and importance of having accumulators, designed for storing and restoring from 20 to 30 per cent. extra power beyond the average requirements, and you can also understand that there is no difficulty or trick about having flywheel accumulators attached to properly handle such conditions, especially as additional wheel accumulators could be applied to the generator shafts as well as to the engine shafts if necessary.

This plant, by way of comparison, as it stands, therefore, should be good for an average of about 2,500 horse power, but if designed with proper flywheel accumulators it could handle with ease an average of 3,000 horse

Now, coming to the case where generators are connected direct to engine shaft, the problem is much easier and cheaply solved when the speed runs from 300 up to 600 revolutions per minute, but when the rotative speed is down as low as 100 revolutions per minute, the problem of attaching efficient and suitable flywheel accumulators becomes much more difficult and costly.

What I have said already will fully explain and provide for the case of direct connected high rotative-speed generators, but by way of variation let us consider the case of slow-speed generators, for example, the large horizontal cross compound Corliss engines of 1,200 horse power being built for the Toronto Railway Company, to the engine shaft of which the generators are attached.

Each of these engines is provided with a specially built-up flywheel, 20 feet in diameter, and having an effective rim weight of say 30 English tons, now running at 90 revolutions per minute, or 1·50 per second, the rim velocity will be 90 feet per second

The total energy stored in flywheel

$$= \frac{WV^2}{948\cdot8} = 250 \text{ horse-power minutes.}$$

Giving 25 horse-power available energy, corresponding to

$$\frac{\Delta V}{V} = \frac{1}{20} \text{ for regulating.}$$

Here also it is at once apparent how helpless this flywheel is to permit of a sudden variation of load without calling upon the entire mechanism and governing gear of engine to act and react, so as to control the proper distribution of steam

In other words, as there is no great accumulated energy the engine indicator cards will vary very much in the same degree as the load resistance.

Although the weight of revolving armature, etc., will add to the energy stored, the engine will still be subject to the varying stresses due to the continually changing load.

Now suppose one or two flywheels of the same weight were built to run at double this velocity, or better, say 200 feet per second, the total available energy for the above fluctuation would be increased to 250 horse power, or fully 20 per cent beyond the average power of engine, viz., 1,200 to 1,450 horse power.

In other words, the engines as designed will average normally 1,200 horse, whereas with engines designed for 125 revolutions per minute, with two flywheel accumulators would give a working average of about 1,500 horse, with greater ease and much better results as to economy.

The following theory of the new flywheel by Prof Sharp, with certain examples and cases worked out, will be found most useful and valuable for reference

THEORY OF THE NEW FLYWHEEL.

Let W = total weight of rim in tons
W^1 = weight of spokes
V = average velocity of rim in feet per second
E = kinetic energy stored in rim in foot-tons
N = kinetic energy stored in rim H.P. minutes
N^1 = Available H.P. minutes corresponding to η
r = the radius of the rim in feet
f = tensile stress on the spokes, tons per square inch
a = angular velocity of wheel
ΔV = difference between maximum and minimum velocities

$\eta = \frac{\Delta V}{V}$ = fluctuation of velocity

s = weight of 1 ft. length of spoke, 1 square inch section = 3·38 lb. = ·00151 tons

a = sectional area of a spoke, square inches
w^1 = weight of one spoke.

Energy of Rim.—

$$E = \frac{WV}{2g} \quad \ldots \quad (1)$$

Differentiate, then approximately $\Delta E = \frac{WV}{g}\Delta V$

$$= \frac{WV^2}{g}\frac{\Delta V}{V} = \frac{\eta WV^2}{g} = 2\eta E \quad \ldots \quad (2)$$

$$N = \frac{2240E}{33000} = \frac{WV^2}{948\cdot8} \quad \ldots \quad (1b)$$

$$N^1 = 2\eta N = \cdot1358\,\eta E \quad \ldots \quad (2b)$$

Energy of Spokes, considered radial.—Consider a small piece of a spoke of length dx, and distant x feet from the centre of the shaft; its weight will be $s\,a\,dx$, its velocity $a\,x$, and therefore its kinetic energy stored in it is $\frac{s\,a\,a^2\,x^2}{2g}\,dx$.

The kinetic energy stored in one spoke will be

$$\frac{s\,a\,a^2}{2g}\int_0^r x^2\,dx = \frac{s\,a\,a^2\,r^3}{6g} = \frac{w_1 V^2}{6g} \quad \ldots \quad (3)$$

Thus the kinetic energy stored up in the spokes is one-third that due to their weight, if concentrated at the rim.

Centrifugal Tension in Spokes, due to weight of rim only.—Suppose that the centrifugal force of each element of the rim is transmitted to the spoke so that when the flywheel is revolving there is no circumferential tension of the rim. Then the total tension on the spokes is—

$$\frac{W\,V^2}{g\,r} = \frac{2\,E}{r} \text{ tons} \quad \ldots \quad (4)$$

The total sectional area of the spokes will be

$$\frac{2\,E}{r\,f} \text{ square inches} \quad \ldots \quad (5)$$

The total weight of spokes is—

$$\frac{2_1 E}{f} = \frac{E}{331f} = \frac{WV^2}{21340f} = \frac{N}{22\cdot47f} \quad \ldots \quad (6)$$

Thus from (6) it seems as if the centrifugal forces due to the weight of the rim be entirely taken up by the spokes, the necessary weight of the latter depends only on the kinetic energy to be stored in the rim, and on the working stress to which the spokes are subjected.

Centrifugal Tension in Spokes, due to their own weight only.—Suppose that the forces due to the weight of the rim are balanced by a circumferential tension in the rim as in the case of a plain ring revolving about its geometrical centre. The tension in a spoke will then be due to its own weight. Consider a spoke of 1 square inch sectional area, an element of it distant x feet from the centre, and of length $d\,x$, will have the weight $s\,d\,x$, and the velocity $a\,x$. The tension in the spoke balancing the centrifugal force of this element is $\frac{s\,a^2\,x}{g}\,dx$.

The total tension at the centre (considering the spokes radial) will be

$$\frac{s\,a^2}{g}\int_0^r x\,dx = \frac{s\,a^2\,r^2}{2g} = \frac{s\,V^2}{2g} = \frac{V^2}{42800} \text{ tons per sq. in.} \quad \ldots \quad (7)$$

In the limiting case, when the stress due to centrifugal force of spoke is equal to f, the safe tensile resistance of the material, we have $V^2 = 42800f$. If the value of f must not exceed 10 tons per square inch, V must not exceed 654 ft. per second.

Circumferential Tension in Rim due to its own weight.—If the centrifugal forces due to the weight of the rim are balanced by a circumferential tension in the rim, this tension is (see Unwin's "Machine Design")

$$\frac{s\,V^2}{g} \quad \ldots \quad (8)$$

Table I. has been calculated from the above equations, and is useful for designing a flywheel to satisfy given conditions.

Case in which the Centrifugal Forces due to Weight of Rim are Balanced partly by Circumferential Tension in Rim, and partly by Tension in the Spokes.—A numerical example will perhaps illustrate the treatment of this case most clearly.

Suppose the rim velocity to be 300 ft. per second, the stresses in rim and spokes at this speed to be 3·5 and 5·10 tons per square inch respectively. (These two values of the rim and spoke stresses must be, of course, assumed, respectively, lower and higher than the values given in the table.)

The tension on the spokes due to their own weight is, from equation (7), or from the table, 2·10 tons per square inch, leaving 3 tons per square inch tension on the spokes to resist centrifugal forces of the rim. Let W_1 be the weight of the part of the rim whose centrifugal forces are taken up by the spokes, then from equation (6) the weight of spokes is

$$\frac{W_1 \times 300^2}{21340 \times 3} = 1\cdot406\,W_1$$

Let W_2 be the weight of the part of the rim whose centrifugal forces are resisted by the circumferential tension of the rim. If this tension existed only over the part W_2 of the rim, it would, from equation (8), or from the table, be equal to 4·20 tons per square inch. Being spread over the whole rim $W_1 + W_2$ of the intensity, 3·5 tons per square inch, we have

$$3\cdot5\,(W_1 + W_2) = 4\cdot2\,W_2$$

from which $W_2 = 5W_1$

Thus taking $W_1 = \frac{1}{2}$ ton, W_2 will be $2\frac{1}{2}$ tons, the total weight of rim will be 3 tons, and the weight of spokes ·703 tons.

The energy stored, from equations (1 *b*) and (3), is

$$\frac{3.234 \times 300}{948.8} = 306.7 \text{ horse-power minutes.}$$

Provided the initial tension on the spokes be correctly adjusted, the stresses on the rim and spokes would be 3·5 and 5·10 tons per

TABLE I.

Velocity of rim. V	Total energy stored per ton weight of rim. N	Available energy per ton weight of rim, $\eta = \frac{1}{10}$. N^1	Weight of rim required for 100 H.P. minutes available energy, $\eta = \frac{1}{10}$.	Ratio of weight of spokes to weigh of rim, $f = 5$ tons per sq. in.	Centrifugal stress in rim due to its own weight.	Centrifugal tension in spokes due to their own weight.
Ft. per sec.	H.P. mins.	H.P. mins.	Tons.		Tons per sq. in.	Tons per sq. in.
50	2·63	·527	189·7	·023	·117	·058
100	10·54	2·108	47·43	·094	·469	·234
150	23·71	4·742	21·08	·211	1·05	·525
200	42·15	8·43	11·86	·365	1·87	·935
250	65·87	13·17	7·59	·585	2·92	1·46
300	94·85	18·97	5·27	·843	4·20	2·10
350	128·9	25·82	3·87	1·15	5·73	2·86
400	168·6	33·73	2·96	1·50	7·48	3·74
450	213·0	42·69	2·34	1·89	9·47	4·73
500	263·5	52·70	1·897	2·34	11·68	5·84

square inch, while the wheel runs steadily with a rim velocity of 300 ft. per second. Taking the number of revolutions per minute 500, the diameter of the rim would be

$$\frac{300 \times 60}{500\pi} = 11.5 \text{ ft.}$$

Circumference of rim = 36 ft.

Section of rim $= \frac{3}{2174 \times 36}$ = square feet,

2174 tons being the weight of a cubic foot of wrought iron—that is, the section of the rim would be 55·2 square inches.

The total sectional area of the spokes is

$$\frac{\cdot 703 \times 144}{\cdot 2174 \times 5\cdot 75} = 91 \text{ square inches;}$$

say 48 pairs of spokes $1\frac{1}{8}$ in. diameter.

Initial Tension on the Spokes.—Let A_s be the total sectional area of spokes (that is, equal to the sectional area of each spoke multiplied by twice the number of pairs of spokes), let A_r be sectional area of rim, f_s and f_r the tensile stresses on the spokes and rim respectively when the flywheel is running at its proper speed, F_s and F_r the corresponding stresses when the flywheel is at rest. Then, evidently,

$$A_s F_s = 2\pi A_r F_r \quad \ldots \ldots \quad (8)$$

the negative sign on the right-hand side of the equation indicating an initial compression on the rim corresponding to an initial tension on the spokes. When the flywheel is running, its radius will be slightly larger than when at rest. Let $x\,r$ be the increment of the radius, E_r and E_s the moduli of elasticity of the rim and spokes respectively. Then the additional tensile stress on the spokes, due to the increment of the radius, will be $x\,E_s$, and the additional tensile stress on the rim will be $x\,E_r$. Therefore

$$f_s = F_s + x E_s \quad \ldots \ldots \quad (9)$$

$$f_r = F_r + x E_r \quad \ldots \ldots \quad (10)$$

Eliminating x from (9) and (10) we have—

$$(f_s - F_s) E_r = (f_r - F_r) E_s$$

or, substituting for F_r its value from (8),

$$(f_s - F_s) E_r = \left(f_r + \frac{A_s F_s}{2\pi A_r}\right) E_s \quad \ldots \quad (11)$$

or,

$$F_s (2\pi A_r E_r + A_s E_s) = 2\pi A_r (f_s E_r - f_r E_s).$$

If the maximum stresses on the spokes and rim f_s and f_r be given, equation (11) serves to determine the proper initial tension F_s to be put on the spokes.

In the example worked out above, $f_s = 5{\cdot}10$ tons per square inch, $f_r = 3{\cdot}5$, $A_s = 91$, $A_r = 55{\cdot}2$, and equation (11) becomes

$$F_s (2\pi \times 55{\cdot}2 + 91) = 2\pi \times 55{\cdot}2 (5{\cdot}10 - 3{\cdot}5).$$

From which

$$F_s (346{\cdot}8 + 91) = 346{\cdot}8 \times 1{\cdot}6$$

$$F_s = 1{\cdot}26 \text{ tons per square inch.}$$

The corresponding initial compression on the rim will be—

$$F_r = \frac{91 \times 1{\cdot}26}{2 \times 55{\cdot}2} = {\cdot}33 \text{ tons per square inch.}$$

Friction between Spokes and Nave.—Let f be the tensile stress in tons per square inch on the spokes when the flywheel is running steadily.

During acceleration of the flywheel rim let the stress on one end of each pair of spokes rise to f_1 while that on the other end falls to f_2. Let θ = arc of contact of spoke and hub, and u the coefficient of friction. The horse power required to accelerate the rim is

$$\frac{2240}{550} (f_1 - f_2) \frac{A_s}{2} \cdot \frac{R V}{r} \quad \ldots \ldots \quad (12)$$

R being the radius of the hub. If the spokes are just on the point of slipping on the hub,

$$\frac{f_1}{f_2} = e^{u\theta} \quad \ldots \ldots \quad (13)$$

Assuming that

$$f_1 + f_2 = 2f \quad \ldots \ldots \quad (14)$$

From (13) and (14),

$$f_2 = \frac{2f}{e^{u\theta} + 1}, \quad f_1 = \frac{e^{u\theta}}{e^{u\theta} + 1} 2f.$$

Substituting in (12)—

$$\text{H.P.} = 4{\cdot}07 \frac{f A_s R \cdot V}{r} \left(\frac{e^{u\theta} - 1}{e^{u\theta} + 1}\right) \quad (15)$$

an equation giving the maximum power that can be transmitted to the flywheel rim.

If the power transmitted at any moment be less than that indicated by equation (15), there will be no slipping of the spokes on the nave.

In the example worked out above (fig. 16,) taking u for iron on iron (dry surface) 0.2, and an arc of contact of $1\frac{1}{2}$ right angles, $\theta = 2{\cdot}356$ and $e^{u\theta} = 2{\cdot}603$. Equation (15) becomes

$$\text{H.P.} = \frac{4{\cdot}07 \times 5{\cdot}10 \times 91 \times 5{\cdot}5 \times 300 \times {\cdot}603}{5{\cdot}75 \times 12 \times 2{\cdot}603} = 10440,$$

which shows that the chance of the spoke slipping round the nave during the ordinary working of the flywheel is very remote. Perhaps the greatest probability of the spokes slipping will be in the case of a bicycle driving wheel, but here again the practical experience of the last eighteen months shows that this possibility may be left out of consideration

Bending Stresses on the Rim.—There will be a bending moment on each radial section of the rim. Considering the portion of rim between two adjacent spokes, neglecting the curvature, the distribution of bending moment is the same as in a beam loaded uniformly and fixed at the supports, so that the elastic line at the supports is horizontal.

Let b = width of rim, h = thickness of rim measured radially, and l the length of rim between the two adjacent spokes, all expressed in inches. Let P be the total pull on each spoke in tons, which will also be the load distributed on the rim between two adjacent spokes. If this portion of the rim were free at the ends, the bending moment on the section midway between the spokes would be $\frac{Pl}{8}$ inch-tons; but the ends being fixed, the bending moment on this section is $\frac{Pl}{24}$, while the bending moment on the sections at the spokes is $-\frac{Pl}{12}$. (See Cotterill's "Applied Mechanics." The maximum and minimum stresses due to the latter bending moment will each be $\pm\frac{Pl}{2b\,d^2}$.

In the example worked out above the spokes are $1\frac{1}{8}$ in diameter and are subjected to a tensile stress of 3 tons per square inch at the rim. P is therefore = 2·66 tons; l is = 9 in., b = 9 in, and d = 3 in. The greatest tensile stress due to bending is therefore

$$\frac{2{\cdot}66 \times 9}{2 \times 9 + 9} = {\cdot}148 \text{ tons per square inch,}$$

showing that the stresses in the rim due to bending are practically negligible.

In closing this paper I must apologize for its being unnecessarily long and so much repetition, but my object was to make this treatise on the subject as complete as possible, and above all to emphasize the necessity for, as well as the many advantages to be derived from, the adoption of improved flywheel construction.

THE Belleville Box and Basket Co., of which J. B. Flint is president and G. L. Grass manager, are building an addition to their premises. They have been very successful since starting last December.

Industrial Notes.

A BICYCLE factory is to be set up in Owen Sound, Ont

P. M. FERNEY, of Toronto, proposes to start a saw-making industry in Ottawa.

THE hands at the Sackville, N.B., foundry struck work last month, demanding higher wages.

R PATTERSON'S planing mill at Hensall, Ont, has been burned down. Loss $7,000; no insurance.

THE Toronto Lumber and Mnfg Co. have assigned, liabilities and assets each about $20,000.

JAS. WILSON'S roller mills at Clarendon, Ont., are undergoing extensive repairs and improvements.

D. OUIMET, plumber, Montreal, got the contract for the hot water heating of Rideau Hall, Ottawa.

C CHOUINARD, hardware merchant, St Henri, Montreal, has assigned on demand. Liabilities $13,000.

SMITH BROS.' stave and hoop mill, at Stewart, Ont, has been destroyed by fire. Loss, $9,000; insurance, $3,000.

THE Assiniboine Lumber Company, Brandon, Man., is applying for incorporation. Capital stock, $100,000.

A NEW steamer is to be built for the line running between Eastport, St. John and New York, at a cost of $75,000.

A. W. HEPBURN, Picton, Ont., is rebuilding the planing mill which was recently burnt. The new building is of brick.

A JOINT stock company has been formed in Digby, N S., for the purpose of constructing a summer hotel at that place. Capital $30,000.

WARKWORTH, Ont., saw mill and grist mill have been destroyed by fire. Loss about $5,000. The fire originated in the engine at the saw mill.

TOMLINSON BROS.' creamery, near Uxbridge, Ont., has been destroyed by fire, including the entire plant. Loss, $6,000; only partially insured.

A SYNDICATE has been formed to buy out the Dominion Organ Works Co. at Bowmanville, and is asking a bonus from the town with this object in view.

THE corner-stone of the Sophia street school at Toronto was laid last month. The building will cost about $22,000, and is to accommodate 600 pupils.

ST. ANDREW'S Church at Belleville, Ont., was destroyed by fire last month. Loss about $35,000; insurance, including organ, etc., about $18,000. The cause of fire is unknown.

A LOCAL company has been formed to build and operate a brewery at Prince Albert, Sask., capital $10,000. It is hoped to build and get the establishment in running order by the new year.

THE Ontario Natural Gas Co. are making quick progress in the work of laying mains in Windsor. Already thirty miles of four, six and eight-inch mains are practically completed. The whole expense of piping will be in the vicinity of $145,000.

E. J. RAINBOTH, C.E., has entered into a contract with Aylmer, Que., town council to construct and maintain a waterworks system at that place, the works to be in operation by Jan. 1st, 1897. The council reserves the right to purchase the works at any time for $35 000, and $1 50 per foot in addition for possible extensions.

DRUMMOND, MCCALL & Co., of the Radnor Forges, Que., have formed a company for putting the product of their recently discovered mineral water well on the market, and the Radnor water bids fair to become as popular as Carlsbad and Appollinaris. The first description of these waters appeared in THE CANADIAN ENGINEER.

CORAM & Co., manufacturers of hand sleds and wooden novelties, Montreal, have secured controlling shares in the Richmond, Que., Water Power & Manufacturing Co., and are now transporting their plant to Richmond. The ratepayers of that town have voted an additional $2,500 bonus to aid the industry, and the company will begin work at once with twenty-five hands or more.

THOMAS MCDONALD & Co. have opened out a shop at 122 William street, Montreal, for the manufacture of galvanized iron boilers and similar goods for household purposes It will be remembered that the McDonald Company were burned out last summer, in consequence of the loss by which Mr McDonald was obliged to assign. He is now doing business on a smaller scale, in company with his son.

THE British American Starch Company, Brantford, Ont., with a subscribed capital of $5,000, is in liquidation.

J M GIBSON, M.P.P., of Hamilton, on the 19th ult., laid the corner-stone of the new Berlin and Waterloo Hospital at Berlin, Ont.

THE corner stone of the new $17,000 House of Refuge building in Toronto was laid last month. It is to accommodate 250 persons.

ARTHUR MURCHISON, of Cornwall, Ont., is establishing a factory in that town for the manufacture of "Pure Cream Baking Powder."

RILEY'S elevator at Cypress River, Man., has been burned, including 10,000 bushels of wheat. Loss $9,000; insurance only $1,250.

THE Warren-Scharf Co. have been awarded the contract for asphalting Adelaide street, Toronto, from Yonge to Church. The price is $12,877.55.

IN Wolfville, N S., a company has been formed for the purpose of building a $25,000 hotel. Work will be commenced this fall and completed about May 1st.

F. T MUMFORD, of Dartmouth, has purchased the foundry and machine shop known as the Oxford, N. S. Foundry, where he hopes to do an extensive business.

THE Robb Engineering Company, Amherst, N.S., are adding to their equipment a large radial drill and a 60 inch milling machine to facilitate the turning out of their famous Robb-Armstrong engines.

HENRI DEBEAU, an employé at the St. Lawrence Sugar Refinery, Montreal, was jerked by some machinery into a centrifugal dryer, which was turning at an enormous speed at the time and was killed instantly.

THOS. CONLON'S lumber mill at Little Current, Ont., is being rebuilt, with all the modern improvements, and will have an increased capacity over the old mill of 20 per cent, which will make its capacity about 125,000 ft. per day.

INFLUENCE has lately been brought to bear upon the Dominion Government to induce them to commence without delay the work of dredging the harbor of Port Dover, Ont., in order to maintain a railway ferry across Lake Erie from Port Dover to Erie, Pa.

THE Ontario Rolling Mills Company's works at Hamilton are closed down, with the exception of the forge department. They will probably re-open within two or three weeks, with the expected improvement in business.

MONTREAL city surveyor recommends the construction of a main sewer, three miles long, at a cost of $132,000, to drain the portion of the city west of Fullum street, the northern part of St. Jean Baptiste ward, and Nicolet and other streets down as far as the river.

THE owners of Quebec's new palace hotel, the "Chatean Frontenac," contemplate enlargements already in the shape of another large building to be connected with the present structure by a covered passage ending with a *fac simile* of the old gates o Quebec.

T. R. DEACON, C.E, of Rat Portage, and W. Kennedy, jr, of Owen Sound, have prepared plans for a waterworks at Rat Portage, to cost $50,000, and the council of that town will shortly submit a by law to raise $60,000 for this purpose and to put in a short sewerage system.

THE widow of the late W. T. Thomas, architect, is bringing an action against the widow of the late Duncan McIntyre, of Montreal, for $38,000, the value of professional services rendered in connection with the construction of the latter's mansion on Drummond street. The building is valued at $250,000.

SUPERINTENDENT DAVIS, of Montreal waterworks says it will require $14,895 to repair the aqueduct, $4,500 for new foundations to the turbines, and $6,260 to replace the wooden work leading to the turbines. It has been discovered that owing to the leaky state of the upper reservoir, water has been for some time percolating into the foundations of McGill College, endangering the stability of the buildings.

THE Kemp Mnfg. Co., Toronto, have started the manufacture of enamelled ware. This is the initial step in an industry that cannot but prove to be of the greatest importance to Canada, remarks the *Canadian Manufacturer*. Heretofore our dependence for enamelled ware of fine quality has been entirely upon the United States; while at the same time the country has been flooded with goods of very inferior quality from both that country and Germany.

MONTREAL Finance Committee recommend the building of a new fire station in the West Ward, at a cost of $60,000.

TORONTO'S old Isolation Hospital in the east end was last month, by the order of the city council, destroyed by fire The building cost originally about $40,000.

THE John Abell Engine and Machine Works Co, agricultural implements, etc., Toronto, have obtained a license to do business in Manitoba.

FAIRBANK, ROGERS & Co 's oil refinery at Petrolea, Ont, was last month visited by a fire, two agitators being destroyed. The cause given is spontaneous combustion Loss, $2,000, insured.

THE Thomas Davidson Mfg. Co, Montreal, capital stock $500,000, has been incorporated for the purpose of manufacturing and dealing in metal and other goods, and operating water power and electric power and light

TENDERS will be received up to the 13th inst. for the construction of a 660 ft. bridge across the Thompson river at Ashcroft, B C. The specifications require two Pratt truss combination spans of 200 feet each

THE WOOD Vulcanizing Co., Ltd., Montreal, capital stock $75,000, has been incorporated. They will manufacture machinery for vulcanizing or otherwise preserving wood, and deal in wood products which have been so treated

R. DUNSMUIR & SONS' cold storage and ice works at Victoria, B C., are now in running order. The plant consists of two multitubular boilers of 100-horse power each, with brick smokestack 100 feet high. The ice-making system employed is the ammonia-brine process.

A PROJECT is on foot in Boucherville, just below Montreal, to build a large floating hotel, at a cost of $25,000, the large steamer "Transfer" serving as a foundation An electric plant also is to be supplied for the purpose of lighting both the hotel and the village. Mr. Pontbriant, of Montreal, has the contract.

A BY-LAW has carried at Brandon, Man., authorizing a bonus of $9,000 to aid Alex. Kelly & Co. in rebuilding their flour and oatmeal mills, which were burned down recently. Contracts have already been let for the work of rebuilding, and it is expected that operations will be going on as usual before the middle of January.

NANAIMO, B C., city council think that the best plan for a water supply for that city will be to get it from the Nanaimo River Falls, so as to provide for future increased requirements. The city surveyor is making an estimate of the cost, which it is not thought will be greater than the price asked by the present company for their plant and contemplated extensions, viz., about $130,000.

THE Lake of the Woods Milling Co (Ltd.), Montreal, have declared a 6 per cent dividend on their capital stock for the year ending 31st August last. Officers have been elected as follows: President and managing director, Robt. Meighen; vice-president and general manager, W. A Hastings, general superintendent, G. V. Hastings, manager, S. A. McGaw, Winnipeg, secretary, F. E. Bray, and assistant-secretary, B. S. Sharing.

W. A. FLEMING, 57 St Francois Xavier street, Montreal, representing Reddaway's patent camel brand belting, has secured the agency for the Menasha wood split pulley. This pulley is manufactured from choice hickory, and a specialty is made of small sizes, from 2 to 8 inches in diameter. It is one of the most satisfactory pulleys in the market and is meeting with a ready acceptance

HORACE R. RIDOUT, of Montreal, writes us as follows. "It having come to my knowledge that other manufacturing firms in Canada are putting on the market a stick-fast belt dressing, and claiming it to be equal to 'Ridout's,' in fact going so far as to say they are manufacturing it for him, I beg leave to say that the article they are making is not my belt dressing, but a poor article, and done to try and injure the reputation I have obtained for mine. I beg to notify my customers and the public that I am the only one manufacturing 'stick fast' belt dressing in Canada, and that it is protected by my trade mark which is on every tin."

PRACTICAL men are making a success of hydraulic mining by the pumping method on Salmon River, says an exchange. Hardman & Babb, who have two leases, 5,900 feet in all, have put in a steam plant and pump water from the river to a height of forty feet. The water is then used in the ordinary way for sluicing. The gravel pays about fifty cents a yard. On the west side of the river, and near its junction with the Pend d'Orielle, Mr. Lichfield is ground-sluicing and prospecting a lease. He also intends to put in a pumping plant. The Kootenay Hydraulic Company, with twelve miles of leases on Pend d'Orielle River, will put in a pumping plant with a capacity of 15,000 gallons a minute.

B. WEHRFRITZ will probably start a brewery and soda water factory at Kamloops, B.C.

WM. MORSE, machinist, of St Thomas, Ont., assigned last month, owing to the foreclosure of a chattel mortgage.

D PORTER, Wiarton, Ont., has received the contract for the improvements to Owen Sound harbor, for which $10,000 was voted at last session of Parliament.

W BOULTER & SONS have opened their new canning factory in Toronto. It has been fitted with the best improved machinery, and now employs over a hundred hands.

THE new bridge over the Maitland river at Wroxeter, Ont., was finished last month. It consists of a single steel span 128 ft. long, 40 ft above the water, with 16 ft. roadway and 5 ft. sidewalk.

A NUMBER of the architects of Toronto and London have made a formal protest against the action of the Free Library Board in accepting the plans of a Brooklyn, N. Y., architect for the new library building in London.

A COMPANY is applying for incorporation for the purpose of manufacturing carriages, wagons, etc, in Outremont, Montreal; capital, $100,000. Those principally interested are Paul Chartrand, E Tougas, A Hébert, P A. Larivière and Israel Charbonneau.

THE new $40,000 steel bridge over the river at Oakville, Ont., was formally opened a few days ago. It has been christened the Aberdeen bridge, the Governor-General having consented to the use of his name.

THE Canadian Furniture Manufacturers' Association have elected the following officers. President, E. F. R. Zoellner, Mount Forest, Ont.; vice-President, Geo. McLaggan, Stratford; treasurer, G. S. Knechtel, Hanover; and secretary, S. R. Shaw, Toronto.

THE *Times* says that the Hamilton glass factory will shortly close down altogether and that the Burlington glass factory will probably be removed to Toronto, unless the city council will, in both cases, grant exemption from taxes, which at present they appear indisposed to do.

ANDREW SOMERVILLE and Daniel Boyd, manufacturers of door sashes, agricultural implements, etc., Huntingdon, Que., who have been under trial for some time for wilfully misrepresenting their financial position, have been committed by Justice Loupret to stand their trial at the next session of the Court of Queen's Bench.

F. J WESLEY & Co.'s woodenware factory, Toronto, was, a few days ago, totally consumed by fire. Loss, $34,000; insured. Fifty men are thrown out of employment. The fire is supposed to have originated in the engine room. The town council having granted exemption from taxes the firm are starting again in the old Hess building.

WITHROW & HILLOCK, contractors and dealers in builders' supplies, Toronto, have failed in their endeavor to arrange with their creditors The depreciation in real estate is at the root of the firm's difficulties. The liabilities are $120,000, and assets nominally the same. The assets are largely in real estate, which was mortgaged for $77,000. The business will be wound up.

DURING the past month there have been various rumors that the Royal Electric Company, of Montreal, was to be amalgamated with either the Canadian General Electric Company or the Stanley Electrical Company, of Pittsfield, Mass. Fred. Nicholls, manager of the C. G. E. Co, has been in Montreal and had a look over the plant, and so has a representative of the Stanley company. At the time of going to press nothing has been concluded.

W. S. PATTERSON, of Wyandotte, Mich., who is thinking of establishing in Guelph or Hamilton, a rolling mill for the manufacture of fine horse shoes, said before the council of that place recently that his idea was to establish a small plant at a cost of from $25,000 to $30,000, and to form a joint stock company. He would employ from 80 to 90 hands, mostly skilled, and the capacity would be 25 tons per day.

J. BOGART, of New York, and F. S. Lewis, of Philadelphia, have been looking over the district near Kakabeka Falls, in the northern wilds of Ontario, where they think of establishing a million-dollar paper mill. The falls are 60 ft. wide and 125 ft. high, and are suitable for the development of vast water power. The region abounds in spruce and other woods The paper manufactured would mostly be exported to the English market.

THE Kingston, Ont., Vehicle Company have completed their organization with a capital of $40,000, and are now preparing to manufacture carriages. The president is Geo. Richardson, of G. & H. Richardson, grain dealers, the manager is W. Walton, late of the Gananoque Carriage Works, and the secretary *pro. tem.* is J. S. Muckleston. Mr. Minnes, of McNee & Minnes, wholesale dry goods, is also interested. The company will open in the old Stephenson piano factory, now vacant.

THE Canada Screw Co. at Hamilton have reduced wages ten per cent.

NEGOTIATIONS are now going on for the purchase of a steam fire engine for Huntingdon, Que.

THE Standard Oil Co. have bought an acre of ground at Port Arthur, and will erect a large storage warehouse thereon.

THE work of building a new city hall in Quebec, for which the legislature has authorized a loan of $150,000, is likely to start this winter.

COTE ST. ANTOINE, Que., council have decided to offer $16,500 for the purchase of land to be used for the erection of a new fire station and city hall.

STEVENS' & BURNS' foundry, London, Ont., is in operation again, but will be known in the future as the Stevens' Mnfg. Co, Mr. Burns having retired.

THE contract for the new House of Industry for the counties of Leeds and Grenville, to be erected at Athens, has been awarded to Simpson & Hagarty, of Brockville, at $11,937.

THE Sawyer-Massey Co. at Hamilton have closed, throwing out nearly 200 men Manager Coburn says the works are not expected to be re-opened before the end of the year.

THE new paper mill at Alberni, B C., which is now in operation, has, besides wood pulp machinery, an outfit of rag and rope cutting machines and a set of paper bag making and printing machinery which will turn out 10,000 bags per hour. It has a machine shop, blacksmith's and carpenter shop. W. Hewartson is manager.

THE Gananoque Buggy Co., whose incorporation was referred to last month, expect to be in working order next month, with about fifty hands to start upon. The machinery, which is now being put in, will be driven by a 60-horse power water wheel made by J. C. Wilson & Co., of Glenora, Ont. George Bennett, who was with the old carriage company, is superintendent of the new factory.

JAMES A. WADDELL, of the Carbon Paint Company, Philadelphia, has written to the Mayor of Toronto, saying their company intend to open a factory somewhere in Canada, and are looking for the most suitable place. The Collins Manufacturing Company is also seeking a site on the Don improvement for the erection of a factory to make patent fencing.

A RECENT issue of the Pembroke *Observer* contained a very full and interesting description of the new water works of that town, which were planned by Willis Chipman, Toronto, and built by Wm. Murray & Co, of Pembroke. The source of supply is Lake Allumette, an expansion of the Ottawa River. The intake pipe will deliver 1,200 gals. a minute, and is 2,300 feet long. The pump is a compound duplex, non-condensing engine, with a high pressure cylinder of 12 inches in diameter, and a low-pressure cylinder 18½ in. in diameter. It makes 50 strokes per minute, pumping 750 gals., or at the rate of a million gals. per day. By means of a valve the contents of the stand pipe can be discharged back through the intake pipe, thus flushing the intake and clearing out the screens. The boilers are large enough to furnish steam for an electric light plant if necessary. In all there are 34,167 feet of piping laid, and the system cost $45,320.

AT the exhibition of fire engineers' appliances at the recent Firemen's Convention, Montreal, the Canadian Rubber Co. had an attractive exhibit of rubber, cotton, fire, and mill hose, firemen's coats and boots, and also some very fine waterproof tweed coats of their own manufacture, showing that there is no need going out of Canada for these goods when our home industries can produce such fine articles. Their "Para" brand of rubber fire engine hose is a very fine and strong hose, and also their "Star" brand of cotton hose, rubber lined, for heavy work. We observed a new brand of cotton hose they had on exhibit, called the "Maple Leaf." The fabric of this hose is from England; it is made with the finest and strongest fibre of cotton, and judging by the fact that it has stood a pressure of 500 lbs. to the square inch, we think it is going to be the coming hose. The Quebec department have just purchased 1,000 feet of it in preference to all others submitted to their committee. All their hose are lined with the patent process seamless tube, giving an unobstructed water way, and a great improvement over the old style of rubber lining. On the whole we must say that the Canadian Rubber Co. have every reason to be satisfied with their exhibit, and it is a credit to Canada that we should have large corporations like theirs willing to go to any trouble and expense towards keeping up the reputation of the country on such an occasion as this one, when practical men from the United States had opportunity of seeing and examining the high grade of goods that the Canadian Rubber Co. manufacture.

Railway and Marine News.

WATER was let into the Canadian Soo Canal on the 24th ult. It stood the test well.

THE British Columbia Dredging Co. (Ltd.), Vancouver, has been incorporated. Capital stock $1,500,000.

N. VERMETTE, who has a planing mill in St. Louis de Mile End, Montreal, has assigned. Liabilities about $22,000,

PREPARATORY work on the new C.P.R. bridge over the Columbia river, Kootenay, will commence in two or three weeks.

J. H. BIRKETT, of the Canadian Locomotive and Engine Works, contemplates the establishment of a bicycle factory in Kingston, Ont.

THE South Shore railway has given a contract to S. Pothier, of Yarmouth, N.S., for putting up railway buildings at Tasket, Lower Eelbrook, and Glenwood.

JOHN TORRANCE, the head of the Dominion Line of steamships, has been elected the new harbor commissioner at Montreal, in the place of the late Chas. Gould.

WORK is progressing on the Gatineau Valley Railway between Pickanock and Desert, a distance of twenty-seven miles. The road will probably be completed this fall.

THE Montreal Gas Co. gave notice a few days ago that from that date the old rates would be resumed, that is, $1.30 for gas for lighting purposes, and $1 for cooking.

THE work of laying rails on the Bangor and Aroostook railroad as far as Presque Isle is now making headway. Trains can now run across the bridge over the creek at Monticello.

THE Massawippi Valley Railroad Co. have elected Wm White, president; Austin T. Foster, vice-president; John G Foster, secretary; and Jas. H. Williams, treasurer.

IN the case of Beauchamp *vs.* Montreal to recover $500,000 in payment of certain debentures in aid of the St. Lawrence and Atlantic Railway, judgment has been given in favor of plaintiff.

THE International Steamship Co., Yarmouth, are having a new vessel built for them in Maine. It is to be 262 feet long, will register about 2,000 tons, and is to be ready for service by next season.

THE Government dredge has taken about 68,000 cubic yards of sand out at the mouth of the Red River, near Selkirk, Man. There is now a channel 127 feet wide, giving 14 feet of water, from one end to the other.

F. B. MCNAMEE and W. Mann, of Montreal, have been awarded the contract for deepening Lachine canal between St. Gabriel locks and Lachine. The price is about half a million dollars. Work will commence at once.

SUPERINTENDENT DAVIS, of the Montreal water works, recommends the "Crown" meter for general use, and the committee have given a large contract for supplying such. The prices run from $20.15 to $785.48, according to size.

THE amalgamation of the Windsor and Annapolis and Western Counties railroads came into force on the 1st inst., and the company, which will operate a through line between Halifax and Yarmouth, will in future be known as the Dominion Atlantic Railway Company.

JAMES A, MCMAHON and a syndicate of capitalists have made an offer for the purchase of the St. Catharines and Niagara Central railway. They would pay $200,000 in cash for the road as at present laid, together with the franchise and all privileges, and would then finish its construction. They ask for right of way into Hamilton.

SIR JOHN LESTER KAYE is circulating in London a prospectus on behalf of a syndicate, who propose spending $50,000 in preliminary work on a railway from Calgary to Fort Churchill on Hudson Bay, and a steamship service between Hudson Bay and Europe. Sir John is known in Canada as the manager of the big ranching enterprise in the North-West some little time ago.

THE Richelieu and Ontario Navigation Co.'s steamer "Magnet," on route from Toronto to Montreal, late last month, struck in the Long Sault Rapids above Cornwall. Considerable water was taken in, but the pumps acted satisfactorily, and it was found that not much damage had been done. Mr. Gildersleeve took prompt measures to save the passengers, from inconvenience by chartering a special steamer from Cornwall to remove them. The "Magnet" is now on her route.

TENDERS are called for the formation of a new channel in Lake St Louis, Que., to cost close on $1,000 000

THE Jenckes Machine Company have a contract to supply two locomotive turn tables for the Lotbiniere & Megantic Railway

THE Shore Line railway is to be re-ballasted and put in thorough condition Work is now going on on the Musquash drawbridge

THE propeller "Acadia" broke her cylinder while going into the Beauharnois canal a few days ago, and has been laid up for repairs

THE Public Works Department at Ottawa have awarded the contract for a steam salt-water dredge, for operating at Halifax, to Carrier, Laine & Co., of Levis, Que

THE Dominion liner "Hamilton" went aground at Contrecœur last month in a fog, with a heavy cargo aboard After some difficulty she was got off without much damage.

THE Harvey and Salisbury Railway Co. will shortly rebuild the bridge over Shepody River, for which $4,000 was voted by the Dominion Government It will be of wood

A G T. R train, near Millbrook, Ont., last month, struck a cow on the line and was derailed and badly smashed The engineer, fireman and a brakeman were all killed

THE new branch railway to Port Morien, N.S., is now in condition for traffic. The rails are being laid to Mira Gut, and the road is being graded to the ancient town of Louisbourg.

THE Tring branch of the Quebec Central Railway was opened on the 4th inst by Lieut.-Governor Chapleau Archbishop Begin was present and performed the ceremony of blessing the line.

A COMPANY is applying for a charter authorizing it to construct and operate a railway from some point near Priest's Bay, on Lake Temiscamingue, to some place near Longue Point, on Quinze Lake, Pontiac county.

THE Portage du Fort and Bristol Branch Railway Co are applying for amendments to their charter, with a view to obtaining an extension of time in which to build their line and a connection with the Pontiac Pacific Junction railway, near Quyon.

THE city of Quebec is applying for amendments to its charter empowering it to contract a loan for repairing the dam of the aqueduct at Lorette and to construct a filter for it, also to pay a bonus to aid the Globe Rubber Co in establishing a factory in the city

THE case of the Queen v Larkin, Connolly & Co., to recover over-payments of contract moneys to the amount of $60,000, in connection with the Levis graving dock, Quebec harbor works, and Esquimalt, B C. dock, has been decided against that contracting firm, who will have to refund the $60,000 to the Government.

THE Melbourne Steamship Co. (Ltd), headquarters Montreal, has been incorporated with a capital stock of $45,000. The company will own and navigate vessels between Montreal and Duluth and intermediate ports The incorporators are C. A & J B Cantin, G E & C. A Jaques, all of Montreal, and Frederick Elliott of Denver, Col.

THE *Transport* says that in addition to Mr Huddart's denial, an official contradiction comes from the Great Western Railway Company declaring that there is absolutely no foundation for the statement that they are giving up the support of Milford Haven in favor of Brean as the British terminus for the new fast Atlantic line

THE Richelieu & Ontario Navigation Company, whose steamer "Corinthian" was burnt a year or two ago, were awarded by Judge Tait only $20,000, their claim for the full amount due, viz., $40,000, having been contested by the insurance companies The case was taken to the Court of Appeal, who a few days ago reversed the first judgment and awarded the full amount.

THERE is a rumor abroad that W. K. Vanderbilt proposes to purchase the Quebec, Montmorency & Charlevoix, and the Quebec Central Railways, with the object of extending them as far as the coast of Labrador; and this, it is said, is part of a plan to give to New York the control of Atlantic rapid traffic. Incidentally, the city of Quebec would be improved and considerably extended.

A PUBLIC meeting was held a week or two ago at Millstream, N.B., in order to raise funds for a survey of the proposed line from Havelock to the I.C.R., near Head of Millstream The favored route seems to be down Millstream to the Burpee survey, and along that between Mount Middleton and Mount Hebron to Sussex. A large sum was subscribed on the spot for preliminary expenses of surveying, etc.

A BROCKVILLE, Westport and Sault Ste. Marie Railway train was seized by the sheriff one day last month to satisfy a claim of Cooper, Fairman & Co., Montreal, for steel used in the construction of the line.

THE Department of Railways and Canals will shortly call for tenders for the construction of the Trent Valley Canal, in two sections, one between Peterboro and Lakefield and the other between Lakes Babam and Simcoe

GEO. D FROST has completed the preliminary survey of the two sections of the western outlet of the railway which is to run from Barnesville to St John *via* Loch Lomond, a distance of 23 miles, to connect with the Central Railway.

A DREDGE is now being used to deepen the river bed at Springhill, about six miles above Fredericton, and at Bear Island. Four feet of earth removed would render possible navigation between Fredericton and Woodstock the greater part of the season.

THE steamship "Amarynthia," which went ashore off Montreal harbor, and has subsequently been undergoing repairs in Davie's dry dock, Quebec, is now in sailing order again. Her dry dock expenses were $50,000, besides $7,500 in dock dues.

THE Bertram Engine Works Company, Toronto, have a contract to build two side wheel steamers for the Ottawa Improvement Company. The larger of these two boats will be 140 feet long, 43 feet over guards, 8 ft. 4 in. deep, and 3 ft. 3 in draft, and will be fitted with compound horizontal engines and two boilers of locomotive type 19 ft. long and 4 ft. 10 in in diameter.

SIR JOHN THOMPSON was a few days ago petitioned for a subsidy for that portion of the Montreal, Portland and Boston Railway lying between Farnham and the boundary line, a distance of 21 miles, which has been out of use for some years. The company have now an opportunity to lease it to the Central Vermont Railway Co., provided it is first put into good repair.

JOHN SHORT, second engineer on the steamship "Rose Standish," of St. Stephen, N.B., was killed in the pumping machinery a short time ago The boat was leaking, and Short, having gone into the pump room to start the pumping apparatus, was just coming out through a narrow opening when the machinery seems to have taken a sudden spurt before he could escape. He was horribly crushed and died instantly.

THE Victoria *Colonist* of Sept. 21st contained a large supplement, giving details of the proposed new British Pacific Railway, the paramount object of which will be to open up the resources of British Columbia to a much fuller extent than the C.P.R. has been able to accomplish The road will probably traverse half the length of Vancouver Island, crossing to the mainland about a hundred miles to the north of Vancouver city About 200 miles north-east of Victoria it will enter the Cariboo district. After tapping the Lillooet district, it will cross the Fraser River, and then go in an easterly direction about 150 miles north of the C P.R The route crosses the Rockies and the provincial boundary at Yellow Head Pass, and enters the North-West Territories 100 miles north of Donald. At Yellow Head Pass the line will connect with the Manitoba & Northwestern Railroad.

Mining Matters.

THE "Blue Bird," Kaslo, has started up again and is turning out good ore.

A STEAM 5-stamp mill has just been put in position at the O.K. mine on Trail Creek district, B C.

THE famous Ophir Mine, Ont., is to be pumped out in order to allow Mr Motley to examine its value

THE Province Mining and Dredging Co. (Ltd), Vancouver has been incorporated. Capital stock $1,000,000

DETROIT capitalists have purchased the Rightmeyer salt mines at Kincardine, Ont., and will operate them in future

THE Jenckes Machine Co., Sherbrooke, are preparing a large winding engine for the Nova Scotia Gold Mines Co. at Montague

OPERATIONS have just begun on the "Golden Lode," Mount Uniacke, N.S., the shaft having been sunk to a depth of 400 feet.

ALEX SMITH has a gang at work on the "Surprise," Kaslo district, and the mine is said to give improving prospects every day

A PARKS has the bed-rock shaft at his claim on Smith Creek, Kootenay, down 15 feet, cribbed, with wheel and pump in position.

DENZIER, Schofield & Gibbs are about to start active development work on their claim near Midway, B.C, the "Stemwinder"

A LARGE force will be employed before long in getting out ore at the "Brown Bear" at Fairview, B.C Mr. Merritt, M.E, is in charge

E. D. CARTER, lessee of "No 1" near Nelson, B.C., is in Wisconsin, organizing his company, who will probably start work in a week or two.

THE Truro, N. S., Foundry Co. have commenced work on a compound condensing engine for the Cochrane Hill, N.S., Gold Mining Co.

A BRICK of gold weighing 101 ozs., and valued at $2,00?, was the result of the crushing of two tons of quartz from the mines at Sherbrooke.

THE "Lead King" (Midway, B.C) lead has been discovered, and is 9 feet wide, assaying on an average 30 ozs. of silver, $2 in gold, and 40 per cent. lead.

N. T. EDWARDS, while working on the "Snowshoe," Lardeau Creek district, struck a lead of gold-bearing quartz 4 feet wide, carrying $110 to the ton

J. BISETTE and D. Savoy have flumed the Lardeau Creek above the canon, and think they have good prospects in store. They got $10 in one pan of dirt recently.

A. B. HENDRY has a large force of men employed at the Kootenay Mining and Smelting Works, Pilot Bay, and a quantity of ore will probably be smelted this month.

STEVENS & WHITE, who have been working on the Ironsides mine, near Midway, B C, have sunk through 23 feet of iron capping and have struck some high-grade copper and gold ore.

THE Jenckes Machine Co., Sherbrooke, Que., have shipped to the Dominion Coal Co., Glace Bay, C.B., 100 coal buckets, 8 ft. in diameter by 5 ft. 4 in. high, with a capacity to hold 5 tons.

TORBROOK, N S, iron mines, which have been closed down for some weeks, owing to the Londonderry furnaces being under repair, have now resumed operations, and ore is being shipped regularly.

A NEW discovery of gold in Guysboro' county, N S., near the old workings of the Ecum Secum Gold Mine, has been made recently A find is also reported from Goldenville in the same county.

A SYNDICATE has been formed in England with a capital of $450,000 to work iron ore and mica properties in Frontenac and adjoining county, and the gold belt recently discovered in Clarendon, Ont.

DAVID LEVILY, a miner at South Uniacke, N.S., in hurrying away from a blast, the fuse to which he had just lit, lost his footing and fell, the blast going off almost immediately after. When picked up he was dead.

WM CALDWELL, one of the Lake of the Woods pioneers, is purchasing machinery for a new mine, which, in conjunction with W. G. Motley, an English mining engineer, he is going to open up on Whitefish Bay.

JAS. STARKE, representing a wealthy English syndicate, has received an option on a rich gold belt, which has been discovered in Clarendon township, near Sharbot Lake, on the C P.R. The ore assays $121 in gold to the ton.

RHODES, CURRY & Co, Amherst, have completed the fifty cottages for the Dominion Coal Co. at Old Bridgeport, and have commenced at that place the construction of a miners' hotel, and at Glace Bay a large freight shed and five residences

C. H. DIMOCK, of the Wentworth Gypsum Co., Windsor, N. S., & J. B. King, of J. B. King & Co., plaster manufacturers, New York, have been visiting Mr. Dimock's plaster quarries at Demorselle Creek, where they think of building a mill next summer.

S. UNDERHILL has staked a claim near Thomson's, B.C., which he calls the "Hidden Treasure." The ledge is 40 feet wide, with an ore chute of solid, clean ore 4 feet wide, similar in appearance to that in the "Black Prince." The chute has been traced 150 feet.

STEVENSON & Co. have at length discovered the looked for Skyline vein at the "Morning Star," Ainsworth district. It is 8 feet wide from wall to wall, of black, rotten quartz, with a streak on one wall 14 inches wide of ore, carrying 60 ozs. silver to the ton. The balance of the vein assayed 15 ozs. all the way across.

THE Memramcook, N B., Gold Mining Co. (Ltd.) have elected officers as follows: President, J W. Y Smith, Moncton; vice-president, E. C. Cole, Moncton; secretary (re-elected), H J. Logan, Amherst; treasurer, C. E. Freeman, Amherst. It has been decided to make further tests on the property before abandoning work.

JOHN MCDOUGALD has sold his gold mine at Fifteen Mile Stream, N.S, to J. D. McGregor, of New Glasgow, for $10,000.

MR. STICKNEY has at present 18 men at work on the "Chief" mine, Three Forks, B.C. Large shipments will be in readiness by the winter.

THE last clean-up in the Cariboo, Camp McKinney, was the result of 19 days run, and realized between $9,000 and $10,000.—*Nelson Miner.*

THE Dominion Coal Co has ordered two Lancashire boilers, 30 ft. long by 7 ft diameter, from the Robb Engineering Co., Amherst, N S.

A. E. HUMPHREYS, of Duluth, Minn., intends to ship ore from his mine, the "Idaho," in the Slocan district, this season. G. W. Hughes has been appointed manager.

J. A. FINCH says the appearance of the "Iron Crown" mine on Bear Creek, Slocan, is very satisfactory, and he intends to ship 500 tons of ore from that property during the winter.

A. WHALEN and W. Kirkup have a fine hydraulic claim on McCulloch Creek, says the Kootenay *Mail*. They cleaned up from 100 yards of pay dirt about 20 oz. of heavy, coarse gold.

A LARGE shipment of machinery has arrived from Philadelphia for the new smelting works at Hamilton. This has now been put in and the erection of the superstruction will now go on apace

AT the "Fisher M[illegible]" Three Forks, several men are at work on three tunnels, [illegible] one of which runs from five to fifteen hundred oz of silver ore. The outcrop is fully 40 feet in width.

CHAS. H. PARK, who has a working boad on the "Sundown," a gold claim three and a half miles south of Nelson, has a tunnel in 65 feet, but will have to extend it 300 feet in order to reach the ledge.

A DEPOSIT of platinum ore has been discovered in the township of Snider, near the Tam o' Shanter mine, Sudbury district. It is believed to be richer than that at the Vermillion mine in Denison township.

HY. PEDWELL has discovered what appear to be valuable oil deposits below the surface on concession 12 of Keppel, Ont. He is thinking of engaging the services of an expert to test the value of the property.

THE St. Francis, Que., gold mines have been sold at sheriff's auction to A. McArthur, lumber merchant, Toronto. The mines are now closed, but operations will shortly recommence on a more extensive scale.

A $4,500 ten-drill air compressor is being fitted up at the "Le Roi," Trail Creek, B.C. Thirty men are employed continuously at this mine, and ore is being taken out as rapidly as it can be hauled away to the landing.

Two hundred and ten tons of ore, valued at $236,000, from the McNaughton mines, near Silverton, B C., were shipped to the Omaha smelter during one week last month. Further shipments have been going forward at the rate of 50 tons per day.

READ & ROBERTSON are making progress with their property on Four Mile Ridge, B.C. The "Wakefield" has four feet of good ore in the face of the tunnel, which is in 140 feet. The outcrop at the "Jenny Lind," another mine on this property, shows 4 feet of solid galena, and the tunnel is in 80 feet.

THE owners of the "Sol Holden" mine, on the Columbia, near Smith Creek, have been steadily developing their property through the summer. The results of the cleaning up of the bed-rock after the season's sluicing are reported good. Eastern capitalists are said to be negotiating for the purchase of the mine.

THE Consolation Mining Co. have recommenced work on their property on French Creek, B.C. They have spent fully $4,000 in replacing the buildings, hoisting works and flumes, which were swept away by the floods, and now everything is in first class shape. The mine produced $10,000 in the ten months preceding the floods.

N. T. EDWARDS, who has been doing development work on the Snowshoe, B.C. mine, struck a lead of gold-bearing quartz four feet wide, carrying $110 to the ton. Another party reports finding on Pete Walker's claim, the True Fissure, a vein of gold-bearing quartz forty feet wide. There are hundreds of tons of it lying loose.

THE quartz claims on Carne's Creek so far located are all contact veins, and are remarkable for their width. None of the assays so far made exceed $22 in gold per ton. The ore bodies are very large. There is every reason to believe that the Carne Creek placers are equally as rich as those on French and McCulloch Creeks.—*Kootenay Mail.*

LAST month, in Springhill, N S., a monument was unveiled to the memory of 125 miners who were killed by the explosion of February 21st, 1891. Including the pedestal, the monument is 24 feet high, and overlooks the town

W MURDOCH, C E., has leased his property near Lattimer's Lake, N B., containing deposits of tripoli or rotten earth, to some American capitalists, who are organizing a company to begin work early next season They will give Mr. Murdoch a royalty of 25 cents per ton The earth, when dried, has to be burned in a kiln, and the company intend to build one shortly.

CHAS F. LAW, who acted as B C. commissioner at the World's Fair, Chicago, has secured a lease for a mile and a half of land lying near the mouth of Mosquito Creek, Cariboo With the aid of an elliptical drill he has succeeded in proving that that district is very rich in scale gold. Mr. Law is organizing a syndicate in Chicago to work what he thinks will prove a valuable property.

G M SPENCER a short time ago found some rich float on the bank of Kooskenais Creek, and, tracing it up, he found a ledge two feet wide of gold-bearing quartz He stripped the ledge for 25 feet and obtained some fine specimens, free gold being visible to the naked eye in one of them. The claim, which he named the Hidden Treasure, is less than three miles in a direct line from Nakusp.—*Ledge*

A MEETING of the General Mining Association of Quebec was held at Sherbrooke last month, at which Mr. Allan, of Ottawa, was unanimously elected vice-president, to replace Col. J. Lucke, deceased The question of the federation of all Canadian mining associations was taken upand the principle adopted by the meeting. Most of the time was occupied by the members in listening to some interesting papers on mining subjects, and in seeing the principal objects of interest in the neighborhood of Sherbrooke.

THREE Slocan, B C., companies have recently been incorporated under the joint stock companies' law, viz, The Alamo Mining Co., capital, $500,000, and Slocan Mining Co., capital, $100,000, in both of which the chiefly interested parties are A E. Humphreys, N D Moore, J G Williams, all of Duluth, and J. V Allance and H Donally, of West Kootenay. The third is the Minnesota Silver Co., of New Denver, capital stock, $1,000,000. Trustees, A E. Humphreys, G J Atkins, H Donally, W Marshall and J. H. Blackaller

THE attention of the managers of glass, blast, gas and other furnaces is drawn to the notice given by H & H E. Smart, of Wales, regarding the "R Dinas" fire bricks, silicate and gannister. Parties who have continuously used the "R. Dinas" brand of fire bricks in the hottest places of their furnaces in Canada testify that they last longer than any other brick they have used. The word "dinas" being a generic term in Wales for brick, other manufacturers use the term, but the "R Dinas" brand, which is most celebrated, is manufactured only by the Messrs. Smart, of Kidwelly, for whom R E. H Gardner-Buckner is Canadian agent.

ONTARIO FORGE AND BOLT CO.

The liquidation of the affairs of the Ontario Forge and Bolt Co., Ltd., of Swansea, near Toronto, has been proceeding during the past month E R C Clarkson, who was this month appointed liquidator under the Dominion Act, has submitted a statement of the affairs of the company, from which it appears that the direct liabilities are $36,148, while there is due to the Bank of B.N A $9,816 customers' paper of which $2 743 is considered bad There is due to the factory hands $4,528, and to James Worthington $507 as salary and $3,000 in connection with liquidation account. The preferred claims amount in all to $8,469; while the secured claims of the Bank of B N A amount to $103,238. Mr. Worthington had assigned to the bank a mortgage to the amount of $75,000, with various mortgages by Caroline Worthington The encumbered assets are valued at $371,048, as given by the company, being partly in real estate, the machinery being valued at $100,000 and tools at $18,000, but the liquidator gives it as his opinion that these will not produce more than about $100,285 The unencumbered assets amount to $73,784, of which $41,731 is in made-up stock, $11,632 in steel, wire, etc., and $3,874 in scrap metal. The liquidator figures on a nominal deficiency of $31,075 Among the creditors are the following McDonell Rolling Mills' Co., of Toronto, $5,832; Conger Coal Co., $1,536; Elias Rogers & Co., $842, Park Bros. & Co., $592. J. Rosenthal, $581, St. Lawrence Foundry Co, $268; Ontario Rolling Mills, Hamilton, $7,238, Drummond, McCall & Co., Montreal, $1,409. Dominion Wire Manufacturing Co., Montreal, $1,377. Reynolds, Carter & Reynolds, Montreal, $1,181. Reid, Craig & Co., Quebec, $1,131; Dominion Mineral Co, Blizzard, near Sudbury, $507. H. Abbott, Ashcroft, B.C., $429. A McPherson, Longford Mills, Ont., $359; Waterous Engine Co, Brantford, $250. Malleable Iron Co., Oshawa, $336; Washburn, Moen Co., Worcester, Mass., $334; Asa T. Cook, Hartford, Conn., $212 There were $5 237 in claims of less than $100 each. A meeting is to be held on the 16th inst to discuss the affairs of the company, their works in the meantime being closed

REVIEW OF THE METAL TRADES.

MONTREAL, OCT. 4TH, 1894.

The increased brightness in the metal trades, owing to the settlement of the tariff bill, still continues, though no great results have ensued so far Several hundred tons of Ayrshire pig iron have been sold at $18, in spite of the old price of both the Canadian and American articles. A good deal of American iron is coming in. For bar iron a fair enquiry is reported, the price remaining about the same The same may be said of heavy hardware. The *Trade Bulletin* quotes prices as follows: Summerlee pig iron, $20.50 to $20.75, Eglinton, $19; Carnbroe, $19; Ferrona, $16.50 to $17; Siemens No. 1, $17.50 to $17, wrought scrap No. 1, $14 to $15 bar iron $1 65 to $1 70. Tin plates, cokes, $2.75 to $3; I. C. charcoal, $3.25 to $3.50, Canada plates, $2 10 to $2.20; terne plates, $6 to $6.25, galvanized iron, 4½ to 5¼c. as to brand. Orford copper, 9½ to 10c., ingot tin, 16½ to 18c.; lead at $2.60 to $2.75, and spelter at $4.50 to $4.75; cut nails, $1.70 to $1.80.

THE enterprise and good management which have marked the Richelieu and Ontario Navigation Company during the past season have resulted in an increase of passenger traffic which is remarkable, especially at a time when business generally has been so dull. The directors last month declared an interim dividend of 3 per cent., the first that has been declared in nine years. The gross earnings from opening of navigation to Sept 22 were $599,870, against $487,395 last year The net earnings gave over 10 per cent. on the capital.

NEWS of the first clean up on the Cariboo and Horse Fly mining property has been received, and shows that one claim rom forty-seven hours' hydraulizing yielded $3,200 On the other 106 hours' work realized $4,900. These claims are situated near Quesnelle Forks, Cariboo district, and are just being developed These results are highly gratifying, and as hydraulic mining in Cariboo has been practically waiting the returns from these claims, it is thought a new era in mining will begin as a result of the clean up, there being an unlimited amount of auriferous gravels lying waste all through the district —*B. C. Commercial Journal.*

The Patent Review.

45,431 Wm Martin, Chicago, Ill., process, apparatus and compound for disinfecting sewers.
45,433 Ernest Egger, New York, N Y., electric car.
45,437 Lorenzo M Smith, Asbestos, Que., hoisting apparatus.
45,438 Wm. E Ludlow, Cleveland, Ohio, bucket hoisting and tripping apparatus
45,439 Henry La Casse, Rochester, N.Y., ball bearing
45,441 Hosea W Libby, Boston, Mass., aërial railway.
45,445 Dennis A Mullane, New Orleans, Louisiana, car coupler
45,448 Henry Xenocles, Zimmerman, LaSalle, Ill., car wheel.
45,449 Francis G. Gray, Ottawa, Ont., pneumatic tire.
45,452 Charles M. Haynes, Omaha, Neb., long distance telephone
45,453 Elisha Gray, Highland Park, Illinois, telautograph.
45,454 John G Dixon, 98 Norman Road, Birkby, York, England, fog signal apparatus.
45,455 Algernon S. Hubbell, Norwich, Conn., bench vise.
45,457 Charles C. Bruckner, Chicago, Ill., engraving machine.
45,463 Charles S. Schellenberger, Streater, Ill., earth augur.
45,464 Samuel L. Park, St Kilda, Victoria, Australia, printing machinery
45,465 Johannes H. F. Görges, Berlin, Germany, system for operating glow lamps by means of multiphase currents.
45,466 Charles M Allen, Butte City, Montana, process or mechanism for smelting ores and refining metals
45,467 Charles E Lipe, Syracuse, N Y., welding apparatus.
45,468 Marcus Ellsworth, Hudson, Ohio, car brake.
45,473 Esdras Rousseau, Montreal, faucet tag.
45,474 Orrin B Peck, Chicago, Ill., centrifugal amalgamator.
45,476 Erie O. Lofdahl, Rockford, Ill., bit and saw combined.

45,477 Lawrence T Smith, Barrington Centre, R.I., electric cigar lighter
45,481 Wm. Borbridge, Ottawa, Ont., air brake coupler
45,486 Ries and Henderson, Philadelphia, Penn., method of and apparatus for electrically producing continuous metallic line structures.
45,487 Wm. A. Rohr, Montreal, hydraulic air compressing apparatus.
45,489 Dagobert Scheinberger, Vienna, Austria, electric accumulator.
45,492 Wm. V. Schoonhoven Thorne, St. Paul, Minn., car coupler.
45,493 Stephen F. Moore, Minn., polishing machine.
45,494 Jorgen J. Möller, Flentburg, Prussia, telephone circuit.
45,495 Emile Andreoli, Summerleyton Road, London, Eng., electrolytic apparatus.
45,496 Andrew A. Leyare, Alexandria Bay, New York, combined water closet and wash basin.
45,502 Jean Marie Moret, Besancon, France, gear wheel.
45,503 James A Brill, Philadelphia, Pa., axle-box frame.
45,505 Henry H. Eames, Detroit, Michigan, ore pulverizer; also No 45,506 for ore separator.
45,509 George Brousseau, Quebec, Que., ventilator for stoves.
45,510 John H. Wynne, Montreal, hot water heater.
45,514 Wm. A. Milford, Todmorden, Ont., brick kiln.
45,515 George R. Gray, Toronto, cinder sifter.
45,516 Eric A. Starke, San Francisco, Cal., smokeless powder.
45,517 Henry Husten, Tacoma, Washington, method of and means for raising and floating sunken vessels.
45,519 S. E. St. Onge Chapleau, Ottawa, self locking lock.
45,523 George E. Belmor, San Francisco, Cal., steam generator.
45,524 Thomas A McFarland, Chicago, Ill lucidagraph.
45,526 H Wm Richner, St. Louis, Miss., car.
45,527 Robert Harris, Buffalo, N Y., combination tool.
45,528 George Caster, London, Eng., gas meter.
45,532 Mitchell T. Buchanan, Ingersoll, Ont., self-locking roller gate.
45,533 W. H. Henson, Toronto, Ont, cycle tire.
45,534 Hjolmar Johanson, Vancouver, B.C., paint for iron.
45,542 J. H. L. Holcombe, Washington, cut outs for electric lights.
45,543 Allen Bagley, Ypsilante, Michigan, continuous rail.
45,544 David Neale, Fort Calhoun, Nebraska, compressor
45,546 Mitchell T Buchanan, Ingersoll, Ont, tension for metallic fencing.
45,547 Wm. Houston Greene, Philadelphia, Pa., process of producing metallic alloys.
45,552 André Pagnin, Montreal, cart.
45,556 Charles Frederick Lavender, Toronto, method of distilling wood waste.
45,559 Wm H. Hampson, Cambridge, Mass., joint coupler.
45,560 Lewis Petty Davidson, Owen, Wyoming, wrench.
45,563 Harvey H. Burritt, Newark, N J, valve
45,567 Wm Maddin, Westville, N.S, self-acting doors for mines.
45,570 Louis Coté, St. Hyacinthe, Que, machine for forming heel stiffeners.
45,574 Wm. E. Worthen, New York, locomotive.
45,575 Wm P. Negus, West Branch, Iowa, wire stretcher
45,577 Edwin Webster Luce, Meadville. Pa., car brake
45,583 Lewis Edworthy, Hamilton, Ont., moulding machine.
45,584 Charles M. Caughill, Melita, Manitoba, thill support.
45,587 Edward P. Caldwell, Minneapolis, Minn., rail joint.
45,593 Daniel N. Cook, Salem, Mass., window ventilator.
45,594 Egbart Habberton Gold, Chicago, Ill., steam trap.
45,595 Arthur Kitson, Philadelphia, Pa., ore roasting apparatus.
45,596 Wm Morrison, Toronto, water heater.
45,597 John Warren, Sterling, Ont, cheese vat.
45 598 John G. Dixon, Birkby, York, England, railway signalling.