PAGES

MISSING

MR. W. R. McRAE,
Master Mechanic, Toronto Railway Co., Retiring President of the Central Railway and Engineering Club of Canada.

. . THE CENTRAL . . Railway and Engineering . . . . Club . . . . OF CANADA

OFFICIAL PROCEEDINGS

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PROCEEDINGS OF THE CENTRAL RAILWAY AND ENGINEERING CLUB OF CANADA MEETING.

ROSSIN HOUSE, TORONTO, December 22nd, 1908.

The President, Mr. McRae, occupied the chair.

Chairman,—

Gentlemen, I will now call the meeting to order.

The first order of business is the reading and confirming of minutes of the previous meeting. It will be in order for some member to move the adoption of the minutes.

Moved by Mr. Bannon, seconded by Mr. Wickens, that the minutes of the previous meeting be adopted as read. Carried

Chairman,—

The Secretary has drawn to my notice the fact that the majority of new members, who have been brought into the Club have been obtained by the same men, that is there are a few members of the Club who are putting forth an effort to enlarge the membership. As we are now going to start the New Year it is very desirable that an extra effort be put forth, by the members of the Club to enlarge the membership, and I trust that every member will bring in, at least, one new member, and if this is done we will double our membership. I was told by the Secretary that one member has brought in in the neighborhood of fifty members, and if one member can bring in fifty members, surely each member can bring in, at least, one new member.

It has been the rule in the past for the Executive Committee to meet at seven o'clock, but as this hour is inconvenient for some of the members, it has been decided to-night that they will meet at 7.30 in future.

During the past year I am very sorry to say that the papers which have been read to the Club have not been very thoroughly discussed. There has been an inclination on the part of the members to sit in their seats and say nothing and listen. If we are going to get the results which we hope to obtain from our Club meetings, the members must take a greater interest in the papers and the questions which are presented to them, by asking questions, even though they may be classed as foolish questions. Discussions of the greatest interest are sometimes brought out by asking what might be thought a foolish question.

The rule of the Club has been since its inception to have simplicity. The members who have given papers, have put them in very simple language. There has been nothing very technical about them, in the hope that the members would take the paper to heart and discuss it thoroughly. Unfortunately, this has not been done. The discussions have been very similar to the bringing in of members, they have devolved on a few of the members. I hope and trust that in the ensuing year my successor will have better discussions of the papers than I, or my predecessor have had.

Probably at the next meeting or before a notice will be given out regarding our Annual Winter Entertainment. This matter will be taken up by the Executive Committee at their next meeting.

During the year we have had some excellent evenings, and at one of them we had the question box, and if my memory

serves me right, this was one of the most successful meetings that we had, and as retiring President, I would recommend that the incoming Executive Committee take up the matter of the question box system and see if more cannot be done with it, than we did during the past year.

I have nothing of very great importance to say, except, to thank the members of the Executive and the Secretary for the very great assistance they have given me in my weak efforts to occupy the chair, and direct the business of the Club. It has given me very great pleasure indeed. I do not know that I have ever held a position which has given me so much pleasure, and I want to take this opportunity to compliment the Club on the very able and efficient Secretary that we have. I believe the thanks of every member should be given to Mr. Worth for his untiring efforts in the interests of the Club. The Club started under not too auspicious conditions and it has only been by a great deal of hard work on the part of Mr. Worth that our Club is in the flourishing and satisfactory condition that it is at the present time, and I only wish for my successor and the new Executive that the relations between them and the Club are as happy as mine have been during the past year.

The next order of business is the announcement of new members.

NEW MEMBERS.

Mr. E. W. Adler, Supt. Structural & Bridge Dept., Canada Foundry Co., Toronto.

Mr. W. McComb, General Manager, Crown Coal Co., Toronto.

Mr. G. C. Keith, Mechanical Editor, Canadian Machinery, Toronto.

Mr. W. D. Hall, Supt. of Power Plant & Elect. Dept., Sarnia Tunnel, Port Huron, Mich.

Mr. A. Tory, Storekeeper, G.T.R., London.

MEMBERS PRESENT.

V. M. Garland.
S. Turner, Jr.
I. Jefferies.
D. F. Gow.
J. V. Jackson.
W. Almon Hare.
E. Blackstone.
W. Borthwick.
G. F. Milne.
E. H. Wilkinson.
J. F. Campbell.
R. H. Fish.
W. Poulter.
Acton Burrows.
W. H. Bowie.
A. G. McLellan.
S. H. Allen.
G. W. McIntosh.
H. Cross.
E. Logan.
J. Mouldey.
A. M. Carmichael.
T. J. Walsh.
G. D. Bly.
A. M. Wickens.
W. R. McRae.
D. C. Hollowell.
F. J. Clement.
J. McWater.
W. E. Archer.
J. Bannon.
J. Herriot.
G. Baldwin.
A. Lewis.
J. Duguid.
A. W. Durnan.

L. Salter.
J. Griffin.
G. Bernard.
J. Walner.
R. Pearson.
C. L. Worth.
J. W. McLintock.
J. M. Clement.
J. Barker.
J. R. Armer.
H. P. Ellis.
H. H. Wilson.
J. Kyle.
A. E. Hawker.
B. J. Markle.
T. J. Ward.
G. Shand.
J. C. Blanchflower.
L. S. Hyde.

Mr. Acton Burrows,—

Mr. Chairman, just before you pass on to the next order of business, I would like to say that I think the Club is to be congratulated on the result for this year. Everybody knows that this has been a very bad year and I know that in trying to get advertisements, it is sometimes like pulling teeth. We have come out this year with a balance, double what we had last year and considering the adverse circumstances, I think the Secretary deserves a great deal of credit for the amount of work he has put in getting advertisements for the Club Journal.

Chairman,—

The next order of business is the report and discussion of papers or questions submitted by members. We have to-night a paper by Mr. Wickens, one of our members, on the "Electrification of Steam Railroads," following as it does the paper given at our last meeting on the "Electrification of Sarnia Tunnel," I have no doubt it will be of great interest to all of us. I have much pleasure in asking Mr. Wickens to favor us with his paper.

THE ELECTRIFICATION OF STEAM RAILROADS.

The crying need of the Dominion of Canada to-day is transportation, more transportation. This together with the demand for more speed, both for passenger and freight traffic, is the natural outcome of these strenuous times. We, of the Dominion of Canada feel this more particularly because of the great heritage we have in our unbounded West, with its great potentialities and unparalled productiveness. This demand is aggravated by the geographical position of the West, and its almost unparalleled growth. Every true Canadian cannot but rejoice at the great possibilities before us, and, while we are all proud to assist in building up this young and promising nation, we must not forget the grave responsibilities that must follow, and perhaps the greatest one of these is transportation. While we have magnificent distances to serve, we must remember we have great natural advantages to assist us, and we must adapt every expedient to take advantage of them.

Let us for a few minutes consider our present systems, and the possibility of largely increasing the present carrying capacity. We have the greatest stretch of deep waterways in the world from the mouth of the St. Lawrence River to Port Arthur. This great water route has been made possible for an immense traffic by means of canals, locks, etc., where necessary at an immense cost by our Governments. It is also contemplated that many millions more are to be spent for this purpose. Even our enterprising friends to the south of us are spending $100,000,000 for a water way from Lake Erie to the seaboard. These far-seeing business men recognize the great importance of this traffic, but at best these great waterways are slow, and are only open for business about seven or eight months in the year. The present railroads are taxed to their utmost, and cannot begin to keep up to the demand. The evolution of the locomotive has been rapid, and train loads have increased at a wonderful rate, and it seems have about reached the limit. It is only a few years ago that a sixty-ton engine was looked upon as a large engine, while to-day 140-ton engines are common, and cars with 30 and 40 tons capacity as against the old 10-ton freight car. These changes made it necessary to rebuild all bridges and road beds, and has called for heavier rails and a more substantial road bed. In the matter of rails it also seems that the rail makers are having trouble to make a 100 or 120 pound rail that is homogenious and of first-class quality all through. Many of the heavier rails have a spot in the centre that is not satisfactory. Then, again, the up-keep of the road beds is getting more expensive all the time, and serious difficulties in connection with them are continually developing. It seems to me that some form of construction should be devised

that is better than that used on our road beds. Under present form of construction the ties are not sufficient to carry the heavy weights that are continually pounding over them. The ballast may be ever so well tamped under them, still we find the outer ends poorly supported. The ballast seems to work away from the ends, allowing the ends to spring down every time a heavy train passes over them, and means by which the ballast could be kept in place at the tie-ends would make a decided improvement, it seems to be a matter of first cost as to whether such improvement can be carried out or not. I believe we would have fewer accidents from broken rails if the road bed was changed for a new plan. From the statements I have made, you will naturally enquire what is the remedy or perhaps the enquiry will be, is there any remedy and have we reached the limit?

Recent developments in the use of electric traction have been so successful that we may hope for relief. The use of the single phase current for motors seems in a great measure to have opened the way, its many advantages for long distance transmission at high voltages and the methods of step down transformers now in use has removed many of the disadvantages of any direct current system. The electrical engineers of to-day have practically solved the problem of long distance transmission of electricity, and consequently are prepared to carry out power ideas that could not be entertained a few years ago. All these facts point to the coming change in the motive power for trunk lines of our best roads.

The geographical situation of many of the railways is peculiarly adapted for this because of the great number of water powers that are crossed by their lines and in which lies enough power to handle successfully and cheaply many a hundred miles of line. Then again, the recent improvements in the use of steam in large power plants have been such that power can now be delivered at a small cost in fuel and attendance as compared to even the most economical of locomotives. A modern high class generating station of large power, if equipped with first-class reciprocating engines to use the steam from high pressure down to atmospheric pressure, will give the very best fuel results for the steam used, and as there is nearly as much heat left in the steam when it reaches the atmospheric pressure as the engines had used up to that time. We should supply a low pressure turbine to convert this heat into mechanical work, thus almost doubling the power of the engine still using the same steam or the steam that would go to the condenser of an ordinary reciprocating compound condensing engine, as the low pressure turbine would not require any valves or governing mechanism. It would be very cheap to install it. It should be installed between the exhaust nozzle of the reciprocating engine and the condenser, having a generator upon its shaft.

which could be connected direct to the same buss cars, the reciprocating engine generator is connected to.

In a steam plant of this character all heat losses should be kept down to a minimum, and the plant so arranged that a good load factor would be maintained at all times. We had the pleasure of listening to a very able paper on the electrification of the St. Clair Tunnel, by Mr. W. D. Hall, at our last meeting, and from what we learned from that paper it is safe to say electric locomotives are a success and perhaps the most interesting statement made in that paper is that the carrying capacity of the tunnel has been increased at least one-third, and this accomplished at a considerable reduction of the coal bill, although the load factor is very bad. One of the American Railroads has for the last two years been running an electrical zone. Mr. William S. Murray, electrical engineer of the New York, New Haven & Hartford R. R. Co. says, in discussing their experiences, "the minute delays suffered to-day by electrical operation are but a small percentage of those incurred during the period of steam operation on account of errors always common to initiative work, the first few months of operation had been a period of interruption, which was naturally annoying both to the road and to the public. To-day the delays have disappeared, by the removal of their cause." He further says,—"the wisdom of the purchase of a locomotive consisting of two individual half units, the whole or half unit being operative by a single crew has proved itself in the ability of the road to handle 75 per cent. of traffic with half units in use, leaving only 25 per cent. of trains using the whole unit, and utilizing the full draw bar pull." He further says that "by an exhaustive investigation I have found that one pound of coal burned under the boilers of our central station produces twice the draw bar obtained by one pound of coal burned in the fire boxes of the steam locomotive, or in other words the fuel bill for electric traction is one-half that required for steam traction." Again he says, "the greatest value to be experienced by electrification will be the tremendously increased traffic capacity of the present track mileage due to the facility electricity offers in making rapid main line and yard train movement, or stated in another way, it is thus immediately seen that electrification will permit of a tremendous increase in traffic without an increase of track mileage, and thus roads which are faced with the requirements of handling the congested traffic by laying new tracks, which, of course, is the most expensive procedure on account of right of way difficulties, will be led into providing an equal capacity by electrification of the old trackage."

There seems to be many advantages in the use of electric power plainly shown although only a start has been made at it. The New York Central are arranging an immense power house

to handle electrically all trains going in and out of their great New York Terminal Station. Hundreds of trains daily and the smoke from all these locomotives eliminated, the noise of the exhaust steam and pounding drive wheels stopped entirely, and in place a smooth running quiet service comfortably and cleanly handling this immense traffic. Before long reaches of track in our country can be properly electrified there must of necessity be many difficulties to be surmounted, some of which may be of a difficult nature, but not impossible. Perhaps one of the worst will prove to be the snow trouble. Now whether a pantograph system or a third rail system is to be adopted I am not prepared to say, but I do feel safe in saying the ingenuity of our railroad men will get over the difficulty. Nearly all of our Canadian cities are passing smoke by-laws, and the electrification of sections of the roads at all cities would stop that trouble and pave the way for extensions until at last whole roads would be suitably equipped, and equipped in such a way as to largely increase the carrying capacity of the present trackage. The very fact that trains, both passenger and freight, following each other at shorter intervals than they do at present would go a long way in keeping tracks clear of snow trouble. The present electric locomotive is proving itself to be of great efficiency and also to be perfectly adapted for rapid work either on the level or on heavy grades. It is only natural that we can look for improvements in their construction that will meet the most exacting wants of any railroad, with our water powers all harnessed for the work and efficient steam power houses erected where the lines are out of the zone of the water powers it should not be many years before the steam locomotive will be a back number, and will only be used where the traffic is light, and one of our great 140 ton engines will be as much of a curiosity as is that old engine, the Rocket, to-day.

Some of the members present may say: well, the electrification of a railroad is too large a project, and the cost of it will be so great that it will never come. I do not expect to see any railroad undertake electrification of the whole service at once, but it seems to me perfectly plain that it will come, it fact it has arrived. It is here in sections, and there is no doubt but these sections will be increased in numbers, and eventually, each will be extended until whole divisions will be perfectly electrified. We may reasonably ask where it is likely a start is to be made, and from the foregoing facts they naturally point, first, to the most congested districts, and secondly to the most difficult points to maintain good train service, on account of unavoidable grades. Our leading Canadian roads all have numerous places where these difficulties are to be found. Take for instance the G.T.R. right here in Toronto, and let us examine the actual situation for a few minutes. Kindly bear in mind

what I am about to say is not intended in any way to disparage the magnificent railroad service we are now receiving at their hands, but is simply to call your attention to one place that is so situated that electrification should be very carefully considered, and a comprehensive scheme carried out. I do not know the exact number of G.T.R. trains that daily pass through the city, and are made up to leave the Union Station. We do know, however, that the number is so great that our waterfront is almost blocked, and its use for the people of the city so greatly interfered with that it is positively dangerous at times to attempt a crossing to the docks. This trouble has increased so greatly the last few years that the people of the city are crying out for a viaduct, for elevated tracks, for relief, no matter what the cost, and, of course, something must be done for their relief.

When we consider that all through freight trains must pass along the Elspanade and nearly all city frieght is there both for unloading and loading, as well as the many passenger trains, this spot should be considered as a congested piece of railroad. Again when we consider that this most congested place is down in a hole, if I may use the term, that is, we have a good stiff grade to climb no matter which way you want to go out of it, the problem begins to take serious form. The road has spent large sums of money to improve these grades, but the traffic is growing so fast that by the time an improvement is finished they are still up against the same trouble and congestion. There have been rumors that an outside line circling the city will be built to carry all through freights, but even this idea has to provide for some stiff grades on account of the hilly nature of the country and the Don River valley. Let us see what could be done if the Toronto city and vicinity was converted into an up-to-date electrical zone. In the first place build a line from the Mimico yards to the York yards, keeping well back on the high ground and out of the city limits, then with the electric locomotives run all through freights east and west without coming down to the lake level. This piece of road should not be exceptionally high in cost. Cuts and fills are near each other, and there is no rock. There will be some grades and perhaps some rather heavy ones but they will be short as compared with the present ones. The electric locomotives will easily surmount them. This would relieve the city front of a heavy traffic and make a marked improvement from the Humber River to the Don, or through the congested parts of the city. Then all freight cars for city delivery should not be switched through the territory, from say Sherbourne or Berkeley to Bathurst Streets, this would further relieve the water front in the centre of the city, having provided for the handling of freight in this way would relieve the freight trains and tracks in the immediate vicinity of the Union Station giving much

better trackage for passenger trains, then cut out the passenger engines and do all terminal work with electric locomotives. This would get rid of the smoke nuisance which is becoming very bad. It would also eliminate the flying cinders as well as a great part of the noise. There is nothing more terrifying to sensitive people than the exhaust blasts from 5 or 6 locomotives all going at once, some in one direction and some in another. It is quite likely if changes of this kind were inaugurated we would have no more of a three or four million dollar viaduct. Again Toronto is so situated that electrical power shonld be bought for a reasonable price on account of Niagara electric power being right at our door. But suppose a satisfactory bargain could not be made with the electrical companies we are still in a good position to generate the necessary electricity. A first-class power plant could be built on the lake front where coal could be delivered by boat, and where the necessary water could be had just for the pumping of it. A modern steam power station of say 10,000 h.p. would handle a large part of the work and do it for one half of the coal now used on the locomotives. A further reduction in cost of coal could also be made by using a cheaper grade of coal than can be used on locomotives. The capacity of the present trackage would be increased by one-third and the present congestion greatly relieved. We also find that recent improvements on electric roads concerning electric block systems, make it safe to operate trains, closer together, than can be done on steam roads. When an automatic block system device will record in the driver's cab whether the block is clear or not, and if the engineer does not heed it the train will be stopped for him 1,000 feet before reaching the end of the block, beside putting him in direct communication with the despatcher. It must allow, a quicker and more frequent train movement with reasonable safety. It is also stated that the wear on the tires of the drive wheels of an electric locomotive is very much less than that upon the steam locomotive, for the reason that there is less slipping and torque upon the axles is the same all the way round, and with correct sanding devices the slipping of wheels should be almost unknown. The amount of oil used daily would also make a great saving as with the electric apparatus there would be only the axles and side bars to lubricate. It is also said the care of an electric locomotive is less than for steam. Of one thing we may be assured, and that is, when we discard the use of a steam boiler we have got rid of the most expensive part of the locomotive to keep clean, and in good running order; in fact, the heaviest part of the repair bill is upon the boiler.

The centre of gravity on an electric locomotive will be much lower than it is upon a steam locomotive, and this should

tend to keep them steadier upon the tracks, to relieve them of the rolling motion, and thereby be easier upon the rail and road bed. One improvement often is followed by others as a sequence, and this seems to be a case of that kind. There are other places and many of them in the great G.T.R. system where electric traction should prove to be both a benefit and a blessing. Take for instance that climb out of Hamilton going west. What a difference an engine capable of a 50,000 draw bar pull, and can maintain a 10 mile speed up a 2 per cent. grade would make there. We would get up that grade and never know it. Use electric power where it will do the most good then put on the steam locomotive where she has the conditions to make the best showing. Then again look at that spot from St. Catherines to the bridge right next door to the greatest development of electrical power in the world. Here would be an ideal section to make a start on, a stiff grade to climb and numerous trains, both freight and passenger. Electric locomotives of the St. Clair Tunnel type would make a revelation on that piece of road. There are many places upon all our railroads that are ideal spots for electrical zones, and many of them will be utilized in the near future.

I do not suppose that the changes from steam to electric can be made in a jump: it must evolve, and on the way many difficulties will appear. Some of them may be serious and troublesome to overcome. Others will be easily righted. It goes a long way toward winning a race to get a good start, and it seems the single phase alternating current series motor has arrived and made a good start. Permitting as they do a high trolley voltage and the use of transformers upon the locomotive to reduce the trolley voltage suitable for use at the motors and the fact that these motors have the same speed and torque as the direct current series motor has. The high trolley voltage gives good economy in long distance transmission and only requires one trolley, while the low motor voltage gives a minimum of motor trouble. It appears the coming troubles will only be of a minor character, in as far as the locomotive itself is concerned. We may expect most of the troubles to come from external and climatic causes, none of which should prove to be unsurmountable. The goal to be reached is so important that many sacrifices must and will be made before perfect success can be claimed. But the many advantages will more than repay the efforts. If we can increase the traffic by one-third on the present trackage, a very large gain in earning power will be established. If the wear on rails and road bed is reduced, another gain can be made. If we can get double the draw bar pull for each pound of coal burned, besides burning a cheaper coal, another large saving will be effected. The maintenance cost for the electric locomotive should be

cheaper because the steam boiler is discarded. The speed of all trains should be increased and general travel made more comfortable. The danger to property along the tracks from fire would almost be eliminated, and also the danger from fire in case of a wreck. The yearly losses from fires caused by locomotive engines is a very heavy burden for all roads to carry and any measure of relief would be welcome. The use ol electricity on the train for lighting would be comfortable and cheap, and the facility of connecting the cab of a locomotive direct with a divisional despatcher, coupled with an electrically operated block system should reduce the accidents occurring to a minimum. The G.T.R. at Sarnia Tunnel have demonstrated what electrification can accomplish on heavy grades and under adverse circumstances. The New Haven, New York and Conn. R. R. for the last two years have proved what can be done in a congested district and the New York Central R.R. will soon show what can be done in the way of handling trains in the busiest terminal station on this continent, if not in the world. It is reported the New York Central will spend many millions upon this change, consequently the time is not far distant when good precedent will be established, and many places will avail themselves of the opportunity to follow suit.

If we look at the many urban trolley roads that are in successful operation, we find they have in many cases been cheaply built, the roadbeds are uneven, and in many cases follow the ups and downs of the highway they run upon. There has been no money spent in grading, even where they leave the public roads and cross the fields no great attempt is made to grade. In many cases the rail is light, and the roadbed poor.. We also find that most of them are operated from a steam power house, very few of which are up-to-date steam plants. Most of them are satisfied with a compound condensing engine plant that is reasonably efficient, using from 20 to 25 pounds of steam per h.p. per hour, and still in the face of all, these roads handle a very large passenger and freight traffic and are generally dividend earners. Their operations have been reasonably successful, and reasonably safe. Accidents upon them are few and not very expensive when they do happen. Now if we consider an electric locomotive running on one of our good railroads with first-class rails and roadbeds, double tracked and well graded with grades reduced so that steam locomotives can make fairly good time on them, it appears to me that the train movement can greatly be increased upon the same trackage at a greatly reduced cost for operation and upkeep. It is now reported that the New York Central will spend $30,000,000 for electrification of the New York terminals and tunnels.

Chairman,—

I have no doubt you have all listened to Mr. Wickens

with a great deal of interest. Mr. Wickens is to be complimented upon tackling such a subject as this, especially as he is not a traction man. Personally I think there has been many good points brought out.

I notice Mr. Wickens especially mentions snow trouble in connection with the operation of the electric locomotives. I would like to ask Mr. Wickens his reason for thinking the snow would interfere with the operation of the electric locomotives more than in the case of the steam locomotive.

Mr. Wickens,—

Nearly all our railroads spend a great deal of money annually for snow plows, and you often hear of a train being snowed up twenty-four hours. We have also found that the electric cars or locomotives do not seem to do as well in the snow as when they get the rail and wheel without any snow between them, and the reason I spoke of this matter is, that I think this will be one of the difficulties when we have very bad snow storms. I think it goes without saying, if I may use that term, that it is a little more difficult to handle an electric locomotive when you are troubled with sleet and snow. I do not know, however, that it will be a difficulty that cannot be overcome.

Chairman,—

I am sorry but I take a very different view of that part of the paper. I do not know of anything worse than a dead locomotive in a snow storm. Now as regards getting snow between the wheels and the rail, that will, in all likelihood, happen more frequently with the steam locomotive than with a good heavy electric locomotive. There is nothing you can do with the steam locomotive which you cannot do with the electric locomotive. Your units are not going to be tied up on the road the way they are now frequently tied up. It can be pointed out also that there has not been an instance where the electric locomotives are not running when the steam locomotives have been tied up, although a few years ago the electric locomotives were in their infancy. To-day we have devices which we had not a few years ago for cleaning the rails of snow, and there is no doubt in my mind that there will be greater improvements which will keep the lines open under all conditions.

As regards sleet on the overhead wire, that is a thing of the past. It is an undisputed fact that the tractive power of the electric locomotive is 50 per cent. greater than the steam locomotive. If the electric locomotive has the weight it can propel itself while the steam locomotive does not propel itself.

I would like to hear from some of the steam men present on this subject.

Mr. Wickens,—

I would like to say one thing more as regards my idea of having snow troubles in connection with the operation of the electric locomotive. It is not on the straight track, but where cuts are drifted up that the locomotive will have trouble. If we can make a dash with the steam locomotive and back out, we are all right. If you can do that with the electric locomotive you also would be all right. However, I am not prepared to say whether this is possible. The point I had in mind was not the snow on a straight line, but in cuts that the electric locomotive would have trouble.

Chairman,—

What is there that a steam locomotive can do in an emergency, that an electric locomotive cannot do?

Mr. Wickens,—

Personally, I am in favor of the electric locomotive.

Mr. Armer,—

I am not in a position to speak on this matter having had no experience in running locomotives in actual service, but would like to ask, how you would proceed when you get the electric locomotive off the track in a snow drift. Can you get it back on the track without any extra assistance?

Chairman,—

The replacers will give you contact if all wheels are off. An ordinary chain thrown from some part of the frame work over the rail will give you all the contact you require to operate your motors.

Mr. Armer,—

On the steam locomotive you could use the replacers and back on, but with the electric locomotive you may be too far away from the rails to get connection with the trolley wire.

Chairman,—

There is hardly a possibility of your getting to far away from the track that you cannot make special arrangements to get on again. As long as you can reach the current you can turn the wheels of the electric locomotive. You can put a wire on the trolley by the aid of a wooden pole, and turn the wheels just as well as though you had steam. Then again

you do not have your engine twisting from one side to the other as with the steam locomotive. You have straight power all the time and you will have no difficulty in putting the electric locomotive back on the track again.

It is only a matter of carrying insulating wire in the cab with a bamboo pole shoved on the trolley wire, and another one as a ground wire for the return current, to get the locomotive back on the rail.

Then again, the steam locomotive is top heavy and it is getting to be a serious question as regards the gauge of the rails. I believe Mr. Harriman is on record as having said, that it will be necessary to have a six foot gauge before long to meet the requirements of the heavy rolling stock. That is just the reverse with the electric locomotive. The entire driving gear is down near the rail and you can take the curves at greater safety. There are innumerable benefits to be derived from operating a road with the electric locomotive as power. There is no doubt that the electric locomotive has come to stay. The geographical outlay of Canada is such that it is not an impossibility to operate a great many thousands of miles on the trunk lines with hydraulic generated current. We have innumerable water falls all the way along our lines.

Now we get back to the single phase question. The apparatus is designed in such a way that the current can be transmitted at an extremely high voltage without the necessity of having sub-stations along the line. The voltage can be reduced right in the cab to a low voltage before reaching the motors. This means an advantage in motor maintenance.

There was one other thing in the paper which interested me very much, but it has slipped my memory just now. However, I would like a little more discussion on this paper.

Mr. Armer,—

I would like to point out one advantage which the electric locomotive would have over the steam locomotive. That is the steam locomotive is apt to run short of coal and water whereas with the electric locomotive you would always have the use of your power, and this is a great advantage. No doubt Mr. Wickens pointed that out in his paper.

Chairman,—

Another thing which Mr. Armer has brought out; the steam locomotive has but two legs, whereas the electric locomotive has four. It is unreasonable to think that all four will give out on one trip; therefore the chances of the electric locomotive being stalled on the line is a great deal less than with the steam locomotive. Then again there are a great many other things which can happen to the steam locomotive which

cannot happen to the electric locomotive. I have never heard any reasonable objection to the electric locomotive from men of theory, science or practical men. Therefore, I am of the opinion that it will be, perhaps, but a short time before all our lines will be electrified at congested centres. Probably within the next five years all the steam roads in the province of Ontario, especially the western section, will be operated with electricity.

Mr. Armer,—

I would like to ask Mr. Wickens a question. He said the capacity of the road would be increased one-third by using electric locomotives. I do not know how you can do that.

Mr. Wickens,—

There are two reasons why you can do that. At our last meeting it was pointed out that at the St. Clair Tunnel the carrying capacity was increased one-third more than it was before, and the actual figures were given us. The gentlemen who are managing the electric roads in the East, all claim, on account of the quicker movement of the electric locomotive, the operation of the trains on the trackage was increased one-third, and I believe that the increase can be made greater than that. I am satisfied that in time electric trains will be run at higher speeds, perhaps with smaller trains. I believe when it is worked out more thoroughly, the increase will be perhaps more than 30 per cent.

Chairman,—

Mr. Wickens, will you explain regarding the use of the turbine which you suggest being placed between the exhaust of the reciprocating engine and the condensers without governors?

Mr. Wickens,—

The matter of using a low pressure turbine is something which is an evolution now in the East. They are putting the steam turbine in on many of the steamships entirely, and find they are delivering a H.P. for 10 or 12 pounds of water or steam per hour, which shows conclusively that the turbine is the cheapest power to run a steam plant. Then the reason I spoke of the low pressure turbine is in this country, in particular, we have a great many factories building real good reciprocating engines of rather a large size. There are none of them, however, building large turbines.

The reciprocating engine will give an efficiency of 12 to 15 pounds. We have been in the habit of throwing the used

steam into the condenser and pumping water there for the purpose of getting rid of it or condensing it. Now we turn that into the low pressure turbine and we convert it into mechanical work, and as there is as much heat left in it, we get nearly as much mechanical work from the steam we were formerly throwing away as we get in the begging from the cylinders. Consequently the low pressure turbine is going to apply itself so well to all.

One strong feature of this low pressure turbine is that it needs no governor or mechanical arrangement except the vanes to turn or generator to carry it. This turbine is very cheap because there is no reciprocating mechanism about it, it is composed of the revolving vanes. There have been a few plants remodeled on that plan, where the output has been almost doubled without using another pound of coal or any more men. In Philadelphia they remodeled a plant of this kind. They were formerly turning out 1,600 amperes load; with the low pressure turbine on the same engines they got 1,100 more amperes, and they did not use any more coal or labor. There is a gain in this case of at least 65 per cent., which came from the use of the low pressure turbine. Last Friday night we had a very elaborate paper in which was cited four different large plants where this plan has been recently done successfully.

Regarding Mr. McRae's question, where you have two generators which have to be synchronized, these operating as they would, would help each other to synchronise. The operating mechanism would give up a little more to the other and the other would catch up and synchronise. I think Mr. McRae can explain this better than I can.

Mr. Wilson,—

While you are on the steam question, I would like to ask a question. A boiler inspector was down to our plant lately and told me of a plant down East where a man took a steam main and opened it at the boiler where it ran to the steam log of the engine main, and he ran it down the brick work and through the combustion chamber. It made a terrible difference in the temperature. If I remember right they raised the temperature about 100 degrees. I would like a little information on this subject if I can get it. I have always been taught and always thought if a pipe did not have water in it and was subject to pressure, it was liable to burst in some way or other, that is, if it is carried in such a place as the combustion chamber of a steam boiler. However, this idea was apparently carried out and put into actual practice. The gentleman mentioned the factory and town. I would like to know whether some other of the members have seen this particular plant and whether it is possible.

Mr. Wickens,—

That is superheated steam and is not unusual and not out of the way at all. There are engines built which their builders will not attempt to run unless they use superheated steam, that is, if they want the steam, say, at 150 degrees more than the pressure. The particular advantage in superheating steam is, that you get the good of the steam before it goes to the cylinder; that is, they use it before any condensation takes place.

The matter of superheating steam is not new. It was attempted in the 60's in the American Navy, and was discarded at that time on account of the oil being used then. Latterly they began to get mineral oils which would stand the high temperature and they are now using the superheated steam to advantage. There are locomotives on the C.P.R. especially up around North Bay, which are running on superheated steam.

Mr. Wilson,—

I appreciate what Mr. Wickens has said; still, perhaps, I did not make myself clear. What I want to get at is, is there any danger to this steam main being passed through the combustion chamber? Other superheaters I know of myself, were always put in the smoke box, but the combustion chamber is a much different place and at times it is a white heat. Of course there is no white heat in the smoke box. I heard one story about this particular plant, that they took these pipes out three months after they were put in and found them all right. The point arises in my mind, during the time the boiler was being steamed up and when the steam was being delivered through the pipe, would this protect it from being burnt? Surely there was not enough condensation in the pipe to prevent it being burnt.

Mr. Wickens,—

The first point is, when we have 130 degrees pressure, we do not add to the heat. We cannot do that unless we lead the steam main away from the boiler where the steam is generated. They do not put this main in the hottest place in the combustion chamber, but put it in a recess in the wall. The superheater is an ordinary steam pipe. In order that it may take up more heat than an ordinary pipe, they put rings on it. This is not to strengthen it, but to permit of it taking up more heat and taking it in more quickly. By heating the steam to a higher temperature you do not add anything to the pressure and therefore your pipe would not burst in the combustion chamber.

Mr. Wilson,—

I can understand that you cannot add anything to the pressure by heating it. However, I would like to ask, what protects that pipe from being burnt. The pipe in the combustion chamber is subjected to a severe heat and I would think it would become carbonized or crystalized, which might make it dangerous. I asked the inspector about drips, and he said there were none on it. What I want to know is, can we pass this pipe through the combustion chamber with safety?

Mr. Wickens,—

If Mr. Wison will write to the Wm. Cameron Co., Montreal, and ask them for literature concerning the Foster superheater, he will get full particulars on the subject.

Mr. Bannon,—

I have nothing in particular to say; however, I think the discussion is getting away from the paper. I think the electrification of steam roads is a very important subject and would like to hear more discussion on it. I am looking for information along this line as it is a thing of value.

Chairman,—

What you have said is very true, yet it occurs to me that if a member should ask a question and if we can answer to his satisfaction, it is time well spent.

Mr. Bannon,—

I agree with you.

Chairman,—

I would like to refer Mr. Armer to page 26 of the Club's previous minutes, where he will find full information regarding the increased traffic in connection with the St. Clair Tunnel.

Mr. Armer,—

Much obliged. I was not here at last meeting night, therefore I overlooked this.

Mr. Keith,—

Regarding what has been said about the ties being broken down by the steam locomotive. If the electric locomotive

will carry one-third larger trains, would not there be the same weight passing over them in a short time and break them down just the same?

Mr. Wickens,—

I do not think I should do all the talking. If any railroad man (I may say I am not a railroad man although I use the trains considerably, and have only one neck) will watch the tracks when a heavy locomotive is going over them, he will notice the rails totter. One reason why this happens is, because the centre of gravity on that engine is very high, and although the driving wheels are counter-balanced, yet they are not always balanced right. If you put the same weight on an electric locomotive, there is no thrust or counterbalancing weight. There is a rolling motion all the time. Then again you are going to get rid of that high centre of gravity and this will save your track considerably.

Then again, you take a large steam locomotive and an electric locomotive of the same weight, the latter will give you double the drawbar pull. This means you can lighten your electric locomotive and get the same efficiency from it as the steam locomotive.

Mr. Jeffries,—

I thoroughly agree with what has been said, that we will have the electric locomotives pretty soon. I would like to know, is there any increased danger to the operators of the locomotives in case of a wreck.

Chairman,—

The voltage used on these electric locomotives is so extremely low that there is hardly any danger to human life. They use 240 volts on these locmotives generally and in surface traction service they use 550 volts. I do not know of any person whose death was directly due to shock received from trolley voltage. Then again, it is only a matter of training your steam engineers in regard to the devices placed at their disposal, that danger will be eliminated.

Mr. Wickens,—

At the St. Clair tunnel the electric locomotives are being run with the steam engineers.

Mr. Bannon,—

We take it that the electric locomotive is run on the single

phase current. You place that current at a low voltage at the motors. What would be the current at the trolley wire, and how long would be the transmission of current between the stations?

Chairman,—

Regarding the length of transmission, this would be governed by the geographical conditions. There is no very high voltage carried on the third rail systems. It is generally of catenary construction. There has been no loss of lives in catenary constructions. The current is brought at a high voltage and dropped down by the transformers in the cab to an extremely low voltage to the motors. On the third rail system they are using practically the same system as we are using on the traction lines. This, of course, is in small zones.

Mr. Wilson,—

Is there any comparison between the elevated electric roads like in New York City, and the steam roads which will be converted into electric?

Chairman,—

There are no overhead trolley systems in the city you mention. The elevated roads are on the third rail system, and surface roads, underground trolleys.

Mr. Bly,—

I did not hear the first part of the paper, however, when you speak about the voltage, do I understand that the transmission line will carry current at 60 to 100 thousand volts, and you would take it at that voltage and reduce it to a low voltage in the cab for the motors?

Chairman,—

There would be no such excessive voltage as that on the catenary. The excessive voltage has been dropped down to say 2,000 volts. This voltage is maintained over the entire system, and at the pressure it enters the locomotive cab, when by the use of transformers, it is reduced to the required potential for use in the motors.

Chairman,—

Is there any other person anything to say on this subject? If not I will declare the discussion of the paper closed.

Mr. Jeffries,—

I would like to move a vote of thanks to Mr. Wickens for his fine paper.

Chairman,—

We will accept your motion, Mr. Jeffries, and hold it over to the close of the meeting.

Chairman,—

We have a motion before the meeting, moved by Mr. Jeffries and seconded by Mr. Burrows, that a vote of thanks be extended to Mr. Wickens for his very able paper which he has presented to-night. What is your pleasure, gentlemen? Carried.

Chairman,—

I have much pleasure in conveying to you, Mr. Wickens, the vote of thanks of the Club.

Mr. Bannon,—

I think this paper should be continued at the next meeting. Mr. Wickens remarked that the paper was not finished, therefore would like to hear further about the question at the next meeting.

Mr. Wickens,—

I thank you, gentlemen, for the vote of thanks. Mr. Bannon spoke of continuing the paper at the next meeting. No doubt the Secretary has already arranged for the next paper, and it would be too bad to disappoint the other fellow. Perhaps it would be better to let it sleep and take the subject up at a later date.

After the election of officers for the year 1909 the meeting was declared closed.