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OFFICIAL PROCEEDINGS

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

PRINCE GEORGE HOTEL, TORONTO, October 18th, 1910.

The First Vice-president, Mr. G. Baldwin, occupied the chair.

Chairman,—

The first order of business is the reading of the minutes of the previous meeting. As everybody has had a copy of the minutes of the last meeting, it will be in order for some one to move that the minutes of the previous meeting be adopted as read.

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

Chairman,—

The next order of business is the remarks of the President. As I have kept you waiting, gentlemen, I will not take up your time with my remarks. Before proceeding to the next order of business I wish to welcome all the new members who happen to be here to-night, and I extend to you a very hearty welcome on behalf of the Club and I sincerely hope you will spend a very pleasant time with us, not only to-night but on all future occasions.

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

NEW MEMBERS.

C. O'H. Craigie, Secretary-Treasurer Canadian Automatic Transportation Co., Toronto.
T. B. Cole, Engineer, Christie Brown Co., Toronto.
P. Peddie, Machinist, Guerney Foundry Co., Toronto.
R. S. Magee, Machinist, Guerney Foundry Co., Toronto.
F. Lewington, Inspector, Canada Foundry Co., Toronto.
J. C. Murison, Inspector, Canada Foundry Co., Toronto.
Wm. Newman, General Superintendent, Polson Iron Works, Limited, Toronto.
J. Sim, Machinist, G.T.R., Toronto.
W. R. Sexton, Manager, Sexton Boiler Setting Co., Toronto.
J. B. Dunlop, Machinist Improver, G.T.R., Stratford.
B. T. Riordan, Machinist Improver, G.T.R., Stratford.

MEMBERS PRESENT.

J. M. Clements.
N. D. McIntyre.
W. Newman.
E. A. Wilkinson.
N. D. Whatmough.
E. G. Southam.
G. Black.
A. M. Adams.
G. A. Young.
R. S. Magee.
J. F. Campbell.
J. Adam.
G. H. Boyd.
F. Sollitt.
J. W. Hetherington.
J. Herriot.
D. Campbell.
W. David.
J. J. Conlin.
E. S. Walker.
A. Campbell.
G. Verner.
G. F. Milne.
S. Tomlinson, jr.
G. Baldwin.
A. T. Bliss.
G. D. Bly.
H. Ellis.
T. McKenzie.
S. Turner.
D. Cairns.
J. Whaley.
W. Schadel.
A. Stewart.
G. S. Browne.
A. W. Carmichael.
J. C. Donald.
W. S. Cowan.
R. Woodward.
J. Greville.
E. Schultz.
J. McWater.
J. Bannon.
W. Moss.
J. B. Dunlop.
H. H. Wilson.
J. C. Murison.
D. Peddie.
F. Hardisty.
W. Dony.
P. McCabe.
L. S. Hyde.
J. Moston.
A. Taylor.
R. S. Worboys.
R. M. Carmichael.
P. Jerreat.
W. R. Sexton.
J. Sharp.
M. McGrath.
J. Wright.
E. Logan.
A. E. Cottrill.
F. D. Dewar.
W. D. McIntyre.
W. R. Gardner.
T. J. White.
R. Pearson.
H. Cross.
J. W. Hazlett.
H. Sayer.
W. R. McRae.
B. Riordan.
F. Lewington.
J. Jackson.
H. Jones.
J. Sim.
C. A. Jefferis.

Chairman,—

We have eleven new members to-night which is very encouraging and we would like to see as many new members at every meeting.

The next order of business is the report of Standing Committee and I will call on Mr. Fletcher to report the progress made in connection with the Social Evening.

Mr. Fletcher,—

I might say that I was one of the Committee appointed to arrange for our next Social Evening. Everything has been arranged and everything is satisfactory so far as I know. We have arranged for the room and bought everything but the prizes, the buying of which, I think, can be left to the discretion of the Auxiliary Committee which I would suggest be made up of Mr. Lewkowicz, Mr. Wilkinson and Mr. Rowell and I presume I shall still retain my standing on that committee.

I may say that as far as the Entertainment is concerned everything is satisfactory.

Chairman,—

You have heard the report of the Committee appointed to make arrangements for the Social Evening. What is your pleasure?

Moved by Mr. Woodward, seconded by Mr. Herriot that the report as presented by the Committee be adopted. Carried.

Chairman,—

I might say here, that the Social Evening will be held at the St. Charles at the corner of Melinda and Yonge Streets, on Friday, October 28th, at 8.00 p.m. sharp.

The next order of business is the reading of papers and discussion thereon.

We have with us to-night Mr. C. L. Hacket, of Montreal, who will read a paper on "Railway Signaling," and I have much pleasure in introducing Mr. Hacket.

RAILWAY SIGNALING

BY C. L HACKET, CANADIAN REPRESENTATIVE OF GENERAL RAILWAY SIGNAL CO., OF ROCHESTER, N.Y.

Railway signaling naturally divides itself into three general heads. Namely, "Interlocking, Block Signals, and Miscellaneous Signals."

The primary reason for the use of signals on a railway is to convey information to the engine driver as to what action he is to take, and when to act. The difference between driving a locomotive, and driving a horse and carriage is a question of momentum. In the case of the locomotive, a weight of several hundred, or thousand tons is moving at high velocity, in the case of the carriage, a weight of a few hundred pounds is moving at low velocity, the control of the one is only approximate except through the lapse of a considerable interval of time, while the other is practically under instant control. Signaling has developed two types of signals, which are known as, a Home Signal, and a Distant Signal. A Home Sinal is a signal located along side of the track marking a definite point beyond which, the engine driver must not proceed, unless the signal indicates that he can do so. As noted above, it is physically impossible to stop a train moving at any considerable speed instantly, therefore if the train is to be stopped before it passes the home signal, some preliminary information must be conveyed to the driver, as to what indication will be presented to him by the home signal. The means employed is the Distant

Signal, which is set in advance of the home a distance depending on the braking distance of the highest speed trains, and is simply a repeater of the home. When the driver finds a distant signal indicating that the home signal is at the stop position, he can apply brakes and bring his train to a stop before he reaches the home signal. If the distant signal is indicating clear the home signal must also be indicating clear.

In modern signaling the semaphore has come into general favor, as giving the best results with unfavorable weather conditions, and changing back grounds.

The indications are given by the arm of the semaphore. The stop indication by the arm in the horizontal position, and the proceed indication by the arm inclined. Until recently the distant signal arm was distinguished from the home by having a V-shaped notch cut out of the end. The indications of the distant signal were the same as the home, that is the horizontal position of the distant arm indicated caution (that the home signal arm was at stop), the inclined position of the distant arm, indicated that the home signal arm indicated clear. There is a confusion here quite apparent, as with the home arm horizontal an indication is given that the engineer must not proceed beyond the signal, whereas the horizontal position of the distant blade indicated caution, "proceed but be prepared to stop at the home signal," and the only distinguishing mark for the distant arm is the V-shaped notch, which is not distinguishable at any distance nor in all weathers, consequently there is serious objections to this horizontal indication having two possible meanings. The latest practice is to have each arm capable of giving three unmistakable indications, i.e., horizontal meaning stop, inclined at an angle of 45 degrees, caution, and vertical meaning proceed. This is more consistent, and it is impossible to mistake the indication.

The fundamental principle underlying the construction of signals, is that a failure in any part should cause the arm of the semaphore to assume the horizontal position, indicating stop. The common practice in America has been to give the indication by moving the arm from the horizontal to an inclined position below the point of support. This necessitates the use of a heavy counterweight to bring the arm back to the horizontal should any part of the signal break, naturally the accumulation of ice and snow on the arm itself would tend to off set this counter weight, and there are cases on record where such accumulation has been sufficient to hold the signal clear, when it should have returned to the horizontal. The German practice has always been to move the arm above the point of support, thus doing away with the heavy counter weight, and with this still further advantage that any accumulation of snow or ice on the blade tends to bring it back to the horizontal. This practice has found favor among the American Signal Engineers, and also is being used on the Western Lines of the C.P.R. and C.N.R. This is unquestionably a move in the right direction and has everything to commend it.

While the day indications of a signal are given by position, the night indications are given by colors. Red has always been used to indicate the stop position, but for the other indications practice has differed on different roads. The different colors are obtained by means of shutters of colored glass which are moved in front of an oil lamp attached to the signal mast. These colored glasses are fastened into the same casting to which the arm giving the day indications is attached, each indication of the arm has then a corresponding color indication. It is essential if the principle of signal construction above referred to, is to be carried out, that the day indications, and the night indications should be given by the same mechanism; that is, it should not be possible to give an indication for proceed with the arm, without at the same time, and by the same means giving this proceed indication with the proper color. There are a good many signals in use in Canada to-day which do not conform to this requirement. The night indication in these, is given by rotating the lamp on its vertical axis, while by means of a pinion gear the arm is made to move. It is under these circumstances easy to conceive of a condition where the night indication would be one thing and the day indication the opposite. This becomes particularly dangerous when we realize that at night, when the engineer gets close up to the signal, the head light of his engine would illuminate the arm, and there are very few engineers who finding the arm indicating clear, would not accept this as sufficient authority to proceed, even though the light on the signal as he approached showed red.

With regard to the question of the proper colors to use for the night indications. As stated above practice has differed in this respect. Some roads use white for the clear indication (white in this case meaning that the lamp flame is not covered by any colored glass), and green for the caution indication of the distant signal. On the other hand some roads use green for the clear or proceed indication, and orange for the caution. If we bear in mind again the principle of construction, it is not difficult to arrive at the conclusion that all night indications should be given by some distinctive color, and in no case should the flame itself be used, except as a stop indication. For if the white indication is used, a broken colored glass would give this indication. Up to the present the only colors with sufficient range to be used as night indications are the red, green and orange.

Another essential point to be remembered in connection with signaling is that it must be made impossible for any of the indications except the stop indication, to be displayed except by an authorized means. That is if the signal is operated by means of levers, then by means of the lever only can any indication be made. This necessitates the use of a rigid connection between lever and signal, or if wire is used there must be a back and front wire, if only a single wire is used to pull the signal clear, any unauthorized person could clear the signal which is manifestly an unsafe condition.

The Standard Code definition of Interlocking is as follows: "An arrangement of switch, lock and signal appliances so interconnected that their movements must succeed each other in a predetermined order." Interlocking in Canada up to the present has been confined to a great extent, to the protection of the crossing of two railways at grade. This is by no means its only possible application, and indeed is probably the least important of its uses. It finds its greatest economy in terminals, junctions, and at points where a great many switches are grouped together, at such points all the

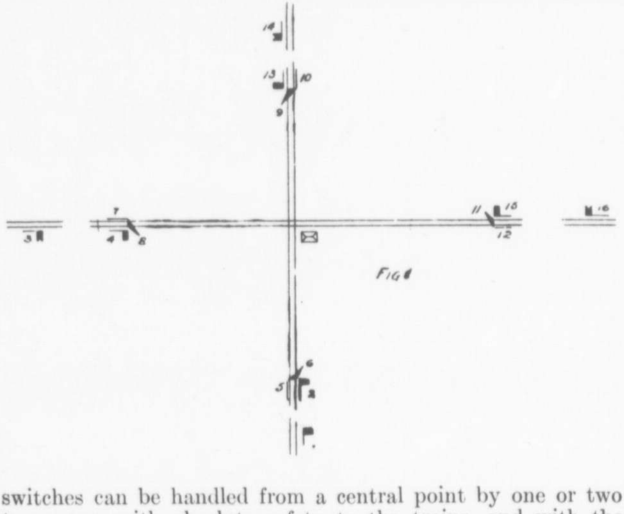

FIG 1

switches can be handled from a central point by one or two towermen, with absolute safety to the trains, and with the greatest amount of expedition.

Under the law in Canada, all trains approaching a grade crossing with another railway, are required to come to a stop before proceeding over the crossing, unless the crossing is protected by interlocking. Aside from the safety afforded by interlocking the crossing, it can be shown that there is an actual saving in operating expense when the trains reach a certain number. Henderson in his "Cost of Locomotive Operation" estimates that it cost in the neighborhood of sixty-five cents to stop a train and again accelerate it to its original speed. Mr. Peabody, Signal Engineer of the Chicago & North-western Railways, after having experimented with different trains, concluded that it averaged forty-five cents per train. For the sake of illustration if we take forty-five cents as the cost it is an easy matter to determine how many trains per day will justify the expenditure necessary to install interlocking at a crossing. Fig. 1 shows in diagram the signaling necessary to protect a single track crossing a single track. There would be sixteen levers. This sized plant installed would cost $4,800, and would require a day and night towerman to operate it. The yearly cost for the plant would stand about as follows:

Cost of interlocking, complete..........		$4,800.00
Interest on cost, 4%..........	$192.00	
Depreciation, 7%............	336.00	
Cost of maintenance per year.	240.00	
Cost of operation per year.....	1,200.00	
Total cost per year...........	$1,968.00	

Saving to be effected—

Trains per day	Cost per year acct. stopping	Total yearly cost of interlocking	Net saving per year	Cost of Interlocking	Time required to pay for installation from saving
14	$1,971	$1,968	$3	$4,800	
20	2,817	"	849	"	5½ years.
25	3,521	"	1,553	"	3 "

It is apparent then that fourteen trains a day over this plant would justify its installation, aside altogether from the saving due to increased safety.

Interlocking is based on the following principles. First, that a failure in any part of the apparatus will prevent a clear signal being displayed. Second, that the normal position of all signals is "stop." Third, that a signal cannot be cleared for a train to move across the interlocking until all the switches in the route are properly set, and locked. Fourth, that a signal cleared locks all the switches, and that no switch or lock can be moved while the signal is clear. Fifth, that the signal cleared guarantees to the engineman the route, with no possibility of a move being made by any other train that could in any way foul the route given. In Canada the first three of these have been always conformed to, but the fifth (fully as essential as the other three) has not. Fig. 2 is a sketch of a plant in operation which does not. A train moving from B to C having received a clear signal No. 1 is not protected from a possible movement by a train from Q which could cause a serious side swipe at the frog A. I have seen several other plants which also have this serious loop hole, and it has been my experience that if a loop hole is left in any signaling installation it is only a question of time when some train will run into it.

In order to prevent a train running by a signal at a crossing the law requires the use of a derailing switch operating in connection with the signals, the signal can only be cleared after the derailing switch has been closed and locked. The closing of the derailing switch on one line locks the derails on the crossing line open, the idea being that if signals alone were used, it would be possible to have a train on the crossing run into by a train on the other line should the engineer disobey the signal. Each individual interlocking plant is a problem in itself, different conditions either in track lay out or operation require different treatment in the location of the signals, and this is the province of the Signal Engineer. The Signal Engineer of a large road is one of the most important officials.

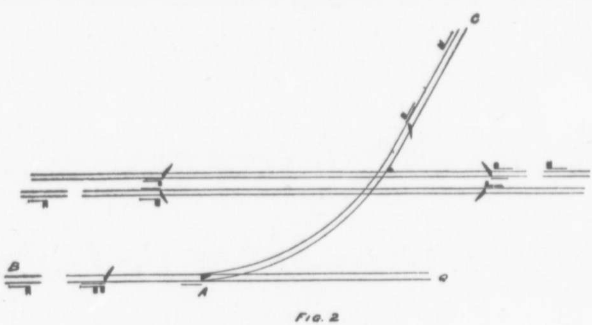

FIG. 2

His knowledge and experience must be large and varied. He should be a civil engineer, and also thoroughly understand how the trains are operated, his duties once the plant is installed is closer allied to the operating end of the railway than to the engineering. In order for him to be able to advise what arrangement of signals will give the greatest results he must be in close touch with the officers who are responsible for the movement of the trains, otherwise his usefulness to the railway is not fully utilized.

In Fig. 1 we have the layout of a simple crossing of one single track line with another. Each derail is handled by a lever situated in a convenient building. The locks for the derails are handled by levers, and the signals by levers. All of these levers are grouped together in a frame, the interlocking between the levers being obtained by the use of cross locking operated by the levers, and held in the lever frame itself. The levers are numbered consecutively from left to right, the derail, switch, lock or signal which they operate being numbered to correspond to the lever. The connection between the levers and the functions being made by means of pipe carried on rollers, the turns in the pipe lines being made with bell cranks. The lock lever also operates what is known as a detector bar, whose function is to prevent the switch or derail being unlocked if there is a train on the track. This detector bar consists of a long bar of steel supported on a number of links pivoted to a casting attached to the base of the rail, free to move in a plane parallel to the track and inclined slightly toward the centre. When the bar is moved the links raise it above the tread of the rail. If, however, a wheel is on the rail the bar cannot be moved as it will be held down by the wheel tread which projects beyond the rail head. This prevents the lock plunger from being withdrawn while there is a car on the track. In Fig. 1 the interlocking between the levers would be.

Reverse	Lever	No.	1	lock	lever	No.	2 reversed		
"	"	"	2	"	"	"	5 "	10 reversed,	13 normal.
"	"	"	3	"	"	"	4 "		
"	"	"	4	"	"	"	7 "	12 "	15 "
"	"	"	5	"	"	"	6 "		
"	"	"	6	"	"	"	8 normal	11 normal	
"	"	"	7	"	"	"	8 reversed		
"	"	"	8	"	"	"	6 normal	9 normal	
"	"	"	9	"	"	"	8 "	11 "	
"	"	"	10	"	"	"	9 reversed		
"	"	"	11	"	"	"	9 normal	6 normal	
"	"	"	12	"	"	"	11 reversed		
"	"	"	13	"	"	"	10 "	5 reversed	2 normal.
"	"	"	14	"	"	"	13 "		
"	"	"	15	"	"	"	12 "	7 "	4 - "
"	"	"	16	"	"	"	15 "		

Thus the first lever to be moved would be the derails, then their locks, then the home signal and last the distant signal, in returning the track to its former position, the order of moving the levers is just the opposite.

Block signals differ from Interlocking signals only in this respect. Interlocking signals indicate a condition of the track and switches, block signals on the other hand indicate the presence or absence of a train in or from a specific length of track. They may indicate the condition of the switches also, but their function is to show whether a train can be admitted to a block section, or whether it is already occupied.

The Block System is a means of moving trains by means of signals, as opposed to moving trains by time table and train orders. The principle on which it is based is that two trains must not occupy the same piece of track at the same time. The line is divided into sections, the limits of which are marked by a signal, and trains are only admitted to one of these sections by means of the signal governing that block. The length of these sections will depend on the number of trains run, their speed, and maximum length.

There are several different methods of block signaling in use. The Telegraph Block System, a block system in which the signals are operated manually, upon information by telegraph. This is simply a make shift and is a combination of the block system and the Standard Code and dispatching system, a combination that cannot be made if the basic principle of block signal operation is maintained. The Controlled Manual Block System, a block system in which the signals are operated manually and so constructed as to require the co-operation of the signalman at both ends of the block to display a clear signal. That is in this system the signal at the entrance end of the block is so interlocked with the signal levers at the outgoing and that it requires the men at each end to co-operate in order to admit a train. There are several types of this system, "The Lock and Block," ordinarily used on double track, where head on movements are not ordinarily made, and the Staff System used on single track, where head on movements must be protected. The Automatic Block System, a block system in which the signals are operated by electric, pneumatic or other agency actuated by a train, or by a certain condition affecting the use of a block. This system does not supercede the train order system of dispatching, and is not absolute, that is from its nature it is necessary where automatics are used to insert the rule, that an engineer finding a block signal indicating stop, must bring his train to a stop at the signal and then proceed, under caution. If this rule is not used the train men would have to flag through the block: the introduction of this rule makes the automatic a permissive signal. For a full discussion of this subject I would refer you to a monograph by Prof. Smart, of McGill, entitled, The Basis of Train Operation, published by the *Canadian Engineer*.

Miscellaneous Signals comprise Train Order signals, used at stations to indicate to the runner whether he is to stop for orders or not: Station signals, used to protect trains standing at stations where no block system is in use. Outlying switch signals used to indicate to a runner, whether or not the main line switch is properly set for him to proceed. Highway crossing signals, used to warn the public at a highway of the approach of a train.

In the case of station signals, it is futile to simply put up a home signal 1,500 feet or 2,000 feet from a station, and expect that this will protect the station. It will not, if a train is running at forty-five or fifty miles an hour, as pointed out above it would be impossible for him to stop at the signal, and if the signal does not mark the point beyond which he must not go, what does mark this? In order for a station signal to be effective it must have a distant signal working in conjunction with it. I have in mind a condition which I saw some time ago at a station, where a freight train had stopped. The caboose was perhaps some fifty feet inside of the station signal, which was indicating stop, approaching the signal at this point there is a sharp curve, a following freight came round the curve and did not have time to stop before it reached the signal, with the consequence that it ran into the caboose of the standing train, a distant signal would have given him the proper preliminary information. The fundamental principle that must be kept ever in mind in signaling is that a failure in any of the parts must produce the stop indication. Thus when we put up a signal at a highway crossing to protect the public using that crossing, it is here just as necessary to keep this principle in view as it is at an interlocking plant. The crossing signal should be so constructed that if any thing fails, the signal should give a positive stop indication to the highway. Most of the highway crossing signals simply consist of a bell, when the bell rings the public understand that a train is approaching the crossing, when the bell is silent it is perfectly safe for them to cross the tracks. This is evidently wrong, a broken wire, a discharged battery or one of several things may happen to prevent the bell from ringing, yet the non-ringing of the bell is an indication in the proceed position, nor does the addition of a light in connection with the bell improve matters. The light is run usually by the same source of power as the bell, anything that will cause the bell to fail will also cause the light to do likewise. A crossing signal to be dependable must be built on the same principle as a signal. It should have a visible stop indication that will show stop should any break occur. The bell is a good adjunct to such a signal, but the visible indication which will take up the stop position by gravity is essential.

Chairman,—

The meeting is now open for the discussion of this paper, and I notice that the railroad members are conspicuous by their absence to-night.

I see two or three railway men here and I have much pleasure in calling on Mr. McCabe, who was on the Grand Trunk like myself, before the interlocking system came into use.

Mr. McCabe,—

I have nothing to say and would suggest that you call on Mr. Black.

Mr. Black,—

I think Mr. Hacket has covered the subject so fully in the paper that it leaves no room for further remarks.

Chairman,—

We have with us to-night Mr. Kirby, Interlocking Inspector of the C.P.R.

Mr. Kirby,—

I am not a member of this Society and I consider it an honor that you have asked me to speak.

I have been very interested in Mr. Hacket's paper, but he did not tell you anything about the start of the interlocking system, when it was first introduced and where it came from. Perhaps, as an Englishman, I would like to say that it originated in the Old Country and as far as I am aware the first interlocking system was introduced there between 1850 or 1860. In 1873 a Select Committee of the House of Lords was called to go into the matter and they found that only forty per cent. of the switches were interlocked at that time and rules were adopted to remedy this.

There is no doubt about the fact that American roads are far away ahead of the English roads in the matter of interlocking. While Mr. Hacket made some reference to the requirements of Signal Engineers on the railroads I must say that Signal Engineers and Inspectors, in fact everyone connected with the signal department, owe a very great deal to the manufacturing companies. We know what we want and when we advise one of these big companies what we want they supply us. They have big works and employ the best men who are familiar with all the latest improvements, and the credit is due to the manufacturers and their skill, for many of the improvements rather than to the Railway Companies.

I do not think I will take up any more of your time, but I would like Mr. Hacket to explain some of the latest improvements that have been made.

Mr. Bannon,—

I would like to ask Mr. Hacket what experience he has had with electrical devices in connection with stopping of trains. I have in mind a system which was being installed between Toronto Junction and the City. I have not heard anything of it since.

Mr. Hacket,—

With regard to automatic train stopping devices, there has never been anything perfected yet. A great deal of thought has been expended on the subject, but nothing has ever been invented that is absolutely reliable with the exception of some automatic train stops that were installed in subways and on elevated structures. You, of course, realize that the conditions in a subway are entirely different from a surface track. In the subway you have not the wet and frost to contend with.

There has always been great difficulty in getting reliable communication from the rails to the apparatus in the cab of the engine and none of the inventors, and some of the cleverest have spent a great deal of time on this subject, have been able to overcome this difficulty, so that the signal engineers on the big roads have not felt warranted in adopting the device.

Speaking of the New York subway, they have automatic signals that are operated on the track. The signals there, as in all automatic installations, are controlled by an electric current on the rails and the automatic stop they use in the subway works in conjunction with the signal. This is nothing more than an arm attached to the rails and when it is in the danger position it sticks up above the head of the rail which as the train passes over opens a valve and lets the air out of the train line, which stops the train. This is necessarily an emergency application. This system is all right where you are running trains in a subway where the weather conditions do not make any difference and there is no one to interfere with the apparatus. If you put anything like that on a surface track, where everybody uses the track as a highway, you would have no end of trouble.

The system that you spoke of that was being tried outside the city, was, I believe, most satisfactory, but I have not heard of anybody adopting it. That system was on the same principle as the Wireless Telegraphic System operated by the hertzeon waves. But these systems are subject to outside interference and where you have high power transmission wires running along side the track you are liable to have all kinds of trouble. The worst that might happen from this would be to stop the train, but on the other hand it might act the other way and show clear when it should show danger, the result I can leave to your imagination. As I said before nothing of this kind has been perfected yet, we will have it some day but it has not come yet.

Mr. McCabe,—

Do you know anything about the Whyte Railway Signal?

Mr. Hacket,—

I am familiar with the Whyte Signal. This is similar to the highway crossing bell I spoke of at the end of my paper. Before the Whyte signal was made use of, we simply had crossing bells, which was just a bell which rang when a train was approaching the crossing. Mr. Whyte thought that was not enough and that a visual indication was the proper thing to have, so that a man who might be deaf and could not hear the bell would see it or in case it was blowing very hard, or from any other cause if the bell could not be heard, the light could be seen, so he devised a signal with a light on it. The power that illuminates the lamp comes from the same source as the power that rings the bell, and if his battery fails, his bell stops ringing and his light goes out, which is wrong. If you are going to have a light on a highway crossing you should get your light from some independent means so that if your bell fails your light would still be burning. My idea is to have an ordinary lamp so that in the event of the battery giving out and the bell stops ringing there would always be a light showing. Again, an oil lamp is far more dependable than electricity, and it entails no hardship for a man to fill the lamp and see that it is lighted, especially as bells have to be inspected everyday.

We have got long burning lamps that will burn continuously for four days with practically no diminishing of the candle power. They will even burn as long as seven and eight days, but it is not safe to rely on them for that length of time.

Mr. McCabe,—

Does it not seem strange that a Railway Commission will recommend a Whyte Signal.

Mr. Hacket,—

I suppose it was the best that they knew of at the time. If I was Signal Engineer on a road, and asked to recommend a highway crossing signal I would certainly make the light independent of the alarm bell.

Chairman,—

Would like to hear from Mr. Jones.

Mr. Jones,—

I do not think that I can add anything further to what has been brought up in the paper, It seems to me that the subject has been fully covered.

Chairman,—

Perhaps Mr. Hardisty will have some comment to make.

Mr. Hardisty,—

I have nothing to say about the interlocking signals. I have been very much interested in what has been said.

Mr. Jefferis,—

I would like Mr. Hacket to tell us of some of the difficulties and troubles he has met with. In order to get Railway Signals up to their present state of perfection there must have been a great many difficulties to overcome, and I would like to hear of some of the difficulties you have met with. I should also like to know what experience you have had in connection with engines using electric headlights.

Mr. Hacket,—

I do not quite grasp what you mean by troubles, troubles in apparatus, or in reading indications?

Mr. Jefferis,—

Mistaking indications.

Mr. Hacket,—

That electric headlights are a source of trouble in yards, I think, everybody admits.

I know that if you have engines running on parallel tracks using electric headlights it does not matter how good your signal lights are you cannot pick them up, especially if you are moving at a high rate of speed, and while most of the roads seem to be using electric headlights now, I have heard of some of the roads that gave them up and went back to the old oil headlights.

When using a white light for clear indication in place of a green the white light is more apt to be affected by the headlight than the green. Green is not so easily picked up as red or yellow but they are all better than white. At one time they tried to use what was called a lunar white. You know the difference between the white of an arc lamp and the light of an incandescent lamp, it was like the arc lamp light, but they found that it cut down the candle power of the lamp and had to be abandoned.

The Chicago & North Western have a very good indication for their distant signals. They get away from the yellow and orange by using a double lamp. They use a red light and green light side by side for caution and when this is changed to clear you have green and white side by side.

By this means the signal lights can never be mistaken for a light in a house or elsewhere on account of a broken glass in a signal, and I believe they have got nearer to the solution of the difficulty than any road I know of.

In Canada we use green almost altogether as a day indication for distant signals. Some roads use yellow which is much easier to pick up than green, in fact I think it is easier even than red. Take for instance in the fall, when there are a lot of trees close to the track and the leaves have turned. The yellow arm seems to stand out much clearer and can be more easily seen than any other color.

There has been a tendency not to take so much notice of the color, but to watch the position of the arm that is how they have got to using three positions. These are similar to a man giving hand signals. I think the use of the three position signals and getting away from colors in the daytime is much better and much easier to read the indications under varying conditions.

Mr. McRae,—

Referring to what Mr. Jefferis said in reference to the use of electric headlights on locomotives. At the American St. and Interurban Convention held at Atlantic City last week I saw a combination headlight which consisted of an arc light and an incandescent light. When going through the country the arc light is in use, but when passing through villages and towns the arc is switched out and only the incandescent is used. I was informed that some of the steam roads were using this combination lamp and that on approaching yards the arc was switched out and the incandescent only used.

Mr. Hacket,—

I have never had any experience with the lights mentioned.

I would like to tell you of a lamp I saw when going through the factory of one of the large glass manufacturers. These people make a specialty of lenses for switch and signal lamps. In the long time burning lamps the candle power is very small, and to increase that they use an optical lense, which, besides increasing the candle power centres the rays.

I saw one of these lenses applied to a headlight. They use an ordinary headlight burner, with an optical reflector, and the result was they got a light almost as brilliant as any electric headlight. The advantage of this light was that owing to the centering of the rays the light shone only on the track on which the engine was running. In Canada there are some pretty bad curves on the roads, and in turning these curves the headlight would naturally not be directly pointing on the track, owing to the small plane of the light. Therefore this light would not work as well on curves, that is, you would not be able to see as far ahead as with the electric headlight with the flat glass, but I think it is a move in the right direction, and is not so likely to be a source of trouble to enginemen on approaching trains.

Mr. Carmichael,—

I saw an article in a paper about a headlight that is going to be revolved by the truck, so that in taking curves the headlight would be pointing down the track.

Mr. Hardisty,—

Is Mr. Hacket familiar with the automatic signals in connection with the Westinghouse airbrake to warn the engineer of the distant signals?

Mr. Hacket,—

Are you speaking of the automatic stop signal applied to the air brake? I spoke of that just now. I do not know of anything that has been perfected except in the cases before mentioned.

Mr. McCabe,—

I think it is the Price system that is being referred to.

Mr. Hacket,—

They have automatic train signaling systems in England, but they are very little better than the ordinary automatic stop in this country. They only give intermittent indications, that is when an engineer gets to a certain point a shoe sticking out from his engine would be engaged by a third rail. This will stop his train but will not tell him everything. Suppose, for instance, the train were to break in two, and part of the train was left in the block, the engine would go on and clear the signal, and the next train that came along would have no warning of the part that had been left behind, until it ran into it, neither would it show any track trouble such as washouts and broken rails.

Mr. Kirby,—

They tried an automatic stop on the underground railway in England the other day. This was a very simple affair. They had something on the rail which caught something on the engine, and shut off the electric power, this was purely a mechanical contrivance.

Mr. McRae,—

At the Street Railway Convention before mentioned, there were a number of train signal systems exhibited, but in none of them could you do away completely with the human element which is always the greatest difficulty. Even in the New York Tunnel system they have to contend with this. While I was there a train-man was discharged for putting an elastic band on the dead man handle to save himself the trouble of holding it down.

Mr. Hacket,—

Mr. Kirby, will you tell us something about the interlocking systems in use in England?

Mr. Kirby,—

They have no train dispatching system in England. The whole length of the railroad system is divided into blocks, with signal towers or cabins, and it does not matter what the distance of the block is there are two cabins to each block. In South Wales in the colliery districts there are signal towers only three-quarters of a mile apart, while in Scotland they are sometimes twenty or thirty miles apart. The distance between the two signal towers constitutes a block, and the signal-men in the towers are responsible for it. The signalmen have telegraph instruments above their levers and they take and give signals to the man ahead. The signalman in one tower asks the man ahead if he can send the train forward, this man answers yes, or no, he also advises when the train has passed through the block.

Mr. Jefferis,—

I have listened with a great deal of interest to Mr. Hacket's paper, and the discussion which has followed, and I move that a hearty vote of thanks be tendered to Mr. Hacket.

Mr. McRae,—

Before the motion is put it appears to me that we, as a Railway Club, should take a deeper interest in this subject, and not merely have it discussed to-night and let it drop. When you consider the great importance of Railway Signaling to the lives of the travelling public, I think a Club of this description should go into this matter very thoroughly, and I would move before Mr. Jefferis' motion, that a select committee be appointed to go into Mr. Hacket's paper thoroughly, and report back to the meeting as a whole next meeting night. A good deal of valuable data can be secured by going into this matter thoroughly, and I think it is far too important a subject to discuss in one night and be let drop, and I think Mr. Hacket would be interested in assisting that committee.

Chairman,—

It has been submitted by Mr. McRae that a committee be selected at the next meeting to look into this matter, and I would suggest it being left in the hands of the Executive Committee.

Mr. McRae,—

I take great pleasure in seconding the vote of thanks to Mr. Hacket.

Chairman,—

It has been regularly moved and seconded that a hearty vote of thanks be tendered to Mr. Hacket for his very able paper which he has given us to-night. What is your pleasure. Carried unanimously.

Mr. Hacket,—

It has given me very great pleasure to meet you all here to-night, and I trust the paper has been of some small interest. If at any time it is decided to go further into this matter, and if I can be of any assistance I shall be glad to do anything that I can. I hope I shall meet you all again, and I have enjoyed it very much to-night.

Chairman,—

I have to apologize to the members for the absence of our President and Secretary. I understand that the President is on his vacation, and as he made up his mind to go shooting I suppose our Secretary thought he ought to go to take care of him. I spoke to Mr. Worth and he told me that his object in going was because he thought he was a better shot than the President, and that I was to promise on his behalf to every member at the next meeting a pair of prairie chickens or a brace of partridge.

I would like to remind the Executive, Reception, and the Amusement Committees that there will be a meeting after this one to make final arrangements for a Social Evening.

With further reference to the number of new members we have enrolled to-night, I would like to draw the members' attention to the fact that we have not got any too many members and we have lots of blanks here, and those who have not got any should come to the table and take what they want. Several times during the last month I have had members come over to my office, and ask me if I had any blanks.

I generally keep a bunch around, and I think it would be well for every member to keep a couple in his pocket.

The next paper will be on "Care and Maintenance of Shop Tools" by Mr. Duguid. This should be a very interesting subject to everybody, and as this paper is by our esteemed President, I have no hesitation in saying that it will be an excellent one. I have heard Mr. Duguid lecture, and I have always found him deal with his subjects in a very able manner. If there is nothing more before the meeting, I would suggest that somebody move that we adjourn.

Moved by Mr. Bannon, and seconded by Mr. Herriott that the meeting be adjourned. Carried.