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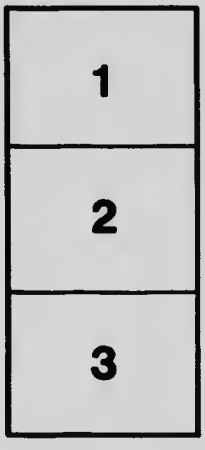

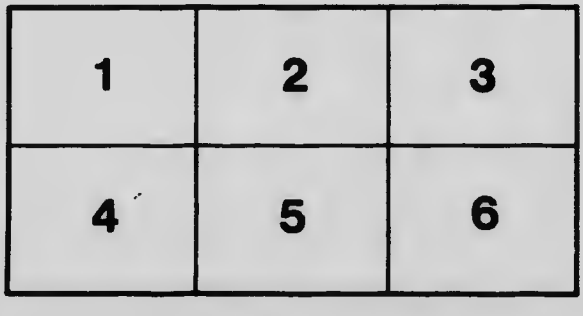

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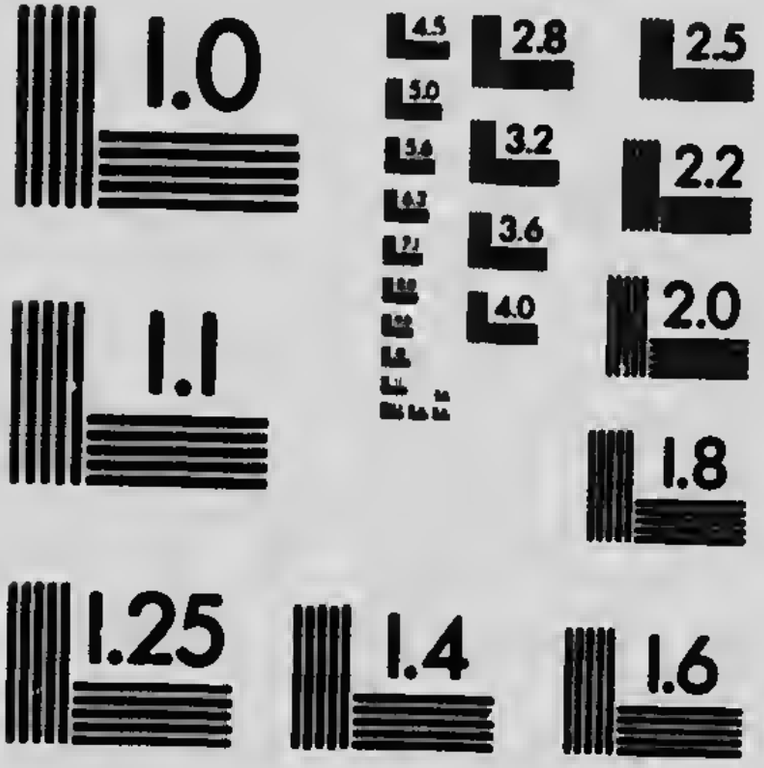

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Papers to be read before the Canadian Street Railway Association

Annual Meeting, Hamilton, Ont., May 29 to 31, 1913.

APPLICATION OF STANDARD CODE OF TRAIN RULES ON ELECTRIC INTERURBAN RAILWAYS.

By Allan Parvis, Manager Interurban Lines British Columbia Electric Ry. Co.

The adoption of uniform code of train rules on interurban railways has been the subject of committee reports and discussions at various conventions of the American Electric Railway Association, but without any definite conclusion having been arrived at. It has been stated that local conditions must govern in this respect, because many interurban lines operate what might be termed "suburban service" on a very much closer headway than the [illegible]er and the placing into effect of rules which would be applicable to the [illegible] could not be properly carried out on the latter.

[illegible] a code of rules based on the principles of the Standard Code, adopted [illegible] American Railway Association, would effect a more uniform know[illegible]f train service, thereby training men to one general idea or system. [illegible] t a later period, men of this type find employment with other com[illegible] experience and training would prove a source of revenue and [illegible] than a handicap, as under the present methods, which lead to [illegible] violations, and a rule, no matter how insignificant, cannot be [illegible] y violated, it sooner or later will result in disaster. I mean by [illegible] nterurban railways should always be manned by men of experience, [illegible], and it is the general practice in hiring men for train service, that [illegible] nave had some knowledge in train rules. If such men are obtainable, [illegible] nave worked on other railways, the system of train rules with previous [illegible] anies may be altogether different from the train rules in force on the

line he is applying for work on. In such cases it may result in accidents, as confusion of different rules would probably lead to it.

The American Code of Interurban Train Rules is a step in the right direction, but still the same confusion might occur in the mind of a man, say, who had been working on steam railways under the Standard Code, entering electric interurban service. The rules materially differ from each other in the essential features, and while the Standard Code would not be adopted in its entirety, with one or two deviations from it, it could, in my opinion, be adopted successfully.

The British Columbia Electric Ry. Co. is, I believe, the pioneer in this respect, as the Standard Code of Train Rules, approved by the Dominion Railway Board and the Province of British Columbia, was adopted and has been in successful operation on its interurban lines since Mar. 1, 1911. The daily service on these lines is 477 scheduled trains during a period of from 5 a. m. until 12.30 a. m.—operation covers from 7½ minutes to approximately a three hour headway—on one branch line a 7½ and 15 minute service is in operation, a total of 208 trains. Prior to the adoption of the Standard Code of Rules referred to, some doubt existed as to the applicability of them—where an infrequent schedule was maintained no difficulty presented itself, but with a close headway of 7½ minutes, it was deemed necessary to make a slight change, in order to cover this feature, without departing to any great extent from the strict interpretation of the Standard Code.

It must be admitted that delays are preferable to accidents, but actual experience has proven that delays do not occur so frequently, nor are they of such duration since trains are operated in strict accordance with the Standard Code of Rules and on time schedules as they were previous to such time. Minor changes in the wording of the Code to suit local conditions may be made without in any way altering the general principle of safety. A deviation was made in the matter of flagging, Rule 99. The Standard Code reads as follows:—

(a) In day time, if there is no down grade toward train within one mile of its rear, and there is a clear view of its rear 2000 yards (40 telegraph poles) from an approaching train — 500 yards / 10 telegraph poles.

(b) At other times and places, if there is no down grade toward train, within one mile of its rear. — 1200 yards / 24 telegraph poles.

(c) If there is a down grade toward train, within one mile of its rear. — 1800 yards / 36 telegraph poles.

The rule as amended to conform to Electric Interurban operation is as follows:—(a) Distance the same. (b) Eliminated entirely. (c) 3000 feet.

In suburban service, where stops are frequent, the continuous accelera-on does not exceed 25 miles per hour, therefore, the distance for flagging is considered ample. In frequent and isolated service, where train operation is adopted under the multiple unit system, motormen have the reverse fea-ture in addition to quick action of their air brakes, which enables a stop to made within the limits of safety. In this instance only have the esse features of the Standard Code been amended, the other rules have successfully carried out without any appreciable delay in train oper

During very foggy, and other stress of weather, in the operation of suburban service, one minute fusees have been adopted—these fu used when a station stop is to be made and before reaching such The one minute fusee allows for ample immediate rear end prot also eliminates any delay in maintaining the running schedule, any lays whatsoever, rule 99 governs absolutely. The above illustrati minute fusee is given to indicate that although such rules can be p successful operation, although not covered by the Standard Code, ru has not in any way been affected by it.

The terminal clearance in double track operation might be elimi as serving no good purpose, although for single track operation, this

of course, very necessary. On suburban service, where the train move ments are more frequent, the terminal clearance can be eliminated and a method adopted to suit a local condition. I submit a sample copy of a clearance used on one of our suburban lines which also serves as a time table, although crews carry time tables also. This does not preclude crews from consulting train registers or registering the variation of watches as instructed by the rules.

I am also submitting a copy of train rules and time tables in effect on the B.C. Electric Ry. Careful perusal and consideration of these rules will show that the Standard Code has not been very materially departed from. They have worked out very successfully, indeed, since their adoption, and I am of the opinion that where employes can be educated to standardization, particularly in such an important matter as train rules, they feel that they are more capable to meet the exacting demands prevailing in railways generally, and it instills confidence in themselves.

One great advantage in train service is that a man who has worked under the Standard Code of train rules for some years, has had that many years' experience which is not thrown away when he enters the service of another company—then he becomes a valuable asset of the company employing him.

BRITISH COLUMBIA ELECTRIC RAILWAY CO.

Date.....

Motor At ..... Leave as Train No. .....

RUN ON FOLLOWING SCHEDULE:

Westbound.									Eastbound.								
	45		30		15		00	New Westminster	50		05		20		35		
	53		38		23		08	Meads	42		57		12		27		
	54		39		24		09	Thorne Road	41		56		11		26		
	55		40		25		10	Connaught Hill	40		55		10		25		
	56		41		26		11	Leeside	39		54		09		24		
	57		42		27		12	McGregor	38		53		08		23		
	58		43		28		13	Fraser Arm	37		52		07		22		
	59		44		29		14	Highland Park	36		51		06		21		
	00		45		30		15	Royal Oak	35		50		05		20		
	01		46		31		16	Jubilee	34		49		04		19		
	02		47		32		17	West Burnaby	33		48		03		18		
	03		48		33		18	McKay	32		47		02		17		
	04		49		34		19	Patterson	31		46		01		16		
10	05	55	50	40	35	25	20	Central Park	30	40	45	55	00	10	15	25	
11	06	56	51	41	36	26	21	Park Avenue	29	39	44	54	59	09	14	24	
12	07	57	52	42	37	27	22	Collingwood E.	28	38	43	53	58	08	13	23	
13	08	58	53	43	38	28	23	Collingwood W.	27	37	42	52	57	07	12	22	
14	09	59	54	44	39	29	24	Earl's Road	26	36	41	51	56	06	11	21	
15	10	00	55	45	40	30	25	Beaconsfield	25	35	40	50	55	05	10	20	
16	11	01	56	46	41	31	26	Nanaimo Road	24	34	39	49	54	04	09	19	
17	12	02	57	47	42	32	27	Gladstone	23	33	38	48	53	03	08	18	
								Lakeview									
18	13	03	58	48	43	33	28	Cedar Cottage	22	32	37	47	52	02	07	17	
40	35	25	20	10	05	55	50	Vancouver	00	10	15	25	30	40	45	55	

Opr.....

Through Trains will turn in Clearance on arrival at each Terminal.

Locals will report arrival at Central Park to Dispatcher, who will clear them. On arrival at Vancouver they will turn in Clearance covering each round trip.

If for any reason you get 15 minutes late, report to Dispatcher.
Next train ahead is.....
Left this station at.....

ALWAYS PROTECT YOUR TRAIN.

RUN NO RISK.

THE PROPERTY SERVING A CITY WITH A POPULATION OF TWENTY THOUSAND OR LESS.

By N. C. Pilcher, General Manager, Sherbrooke Railway & Power Co.

Papers and discussions regarding electric railways usually deal with problems affecting large properties. As many members represent small companies, it has prompted me to read this paper in hope of a discussion that will bring out methods and ideas, useful to companies operating in small cities.

The Sherbrooke Railway and Power Co., acquired the Sherbrooke St. Ry. Co., in the spring of 1910. In addition to doing a railway business in Sherbrooke, we conduct a light, power and supply business in the district of St. Francis. Since acquiring the property, it has been entirely rebuilt; new power plant, roadbed and practically all new car equipment. We use a 70 lb. 7 in. T rail, special work having manganese centres. Considering the population served the outlay was large, but we believe that it was warranted from the operating results attained.

Gross receipts have increased 36 per cent., while the total operating cost for the year 1911—1912 is 8.638 per car mile. Under the franchise we were obliged to increase the mileage from 6 to 10 miles. The mileage in my opinion is too much for a city occupying so small an area and with a population of 18,000. Sherbrooke, however, is a growing city, well situated and the burden of making such a system pay will be lightened as time goes on.

METHODS OF STIMULATING TRAFFIC. — We have considered different schemes for stimulating traffic, but none have given much promise from a financial standpoint. This may be due in a measure to the general layout of the city. There are possibilities in handling freight in carload lots, and in fact less than carload lots to the various industries and between the railways. In order to do this, however, it would be necessary to spend a great deal of money is strengthening bridges, then there are many heavy grades varying between 5 and 12 per cent. We have therefore concluded that in consideration of the initial cost and the extra hazard involved it is not wise at present.

The writer has had some experience with a system of parcel and express business handled by regular cars, but has concluded that it interferes with the service and claims for lost articles are numerous and sometimes costly. Service and the goodwill of the public are among the companies' best assets and should have first consideration. Therefore we advocate uninterrupted service, clean cars and courteous employes as the safest and surest method of getting and keeping business.

STEEL WHEELS. — During the past two years, we have replaced practically all iron wheels with rolled steel wheels. The results have been satisfactory, with one great exception, the wheel account is bigger than ever. This is not due to the poor quality of the wheels nor to the first cost, but to the cost of turning them. We do not operate a machine shop, therefore we are obliged to send wheels out to a local shop to be turned. I have before me an invoice reading:—"46 hours. Pressing on and turning 1 pair wheels, $27.60." Upon investigating the matter I was informed that the outside skin of the wheels was so hard that the machinist was unable for some time to get a tool to touch it. While all our wheels do not cost as much

as mentioned, they all have cost so much that we will be obliged to build a machine shop next year, unless the local firm makes better time in this work. When the cost of turning is reduced to a reasonable basis, we believe that steel wheels will be cheaper than cast iron and more satisfactory. With iron wheels our mileage never exceeded 6500. Wheels were not actually worn out, but were scrapped for flat spots, broken flanges and chipping. Of the steel wheels we have in service some have run 90,000 miles and are good for at least another 25,000 miles. This we consider satisfactory when the heavy grades and number of stops are considered.

PROVINCIAL TAXATION IN QUEBEC. — Street Railways in the Province of Quebec are taxed $50 a mile per year. If a company conducts a power and lighting business then it is taxed 1-8 of 1 per cent. on the paid up capital in the business outside of the railway and $20 for every additional place of business it may have. We feel that this scheme of taxation is unfair to the small companies, especially the $50 a mile. When a small company makes extensions to its system they are not very renumerative for several years and in no case can it compare with a system serving 75,000 people or over. It appears to us that taxation based on earnings would be more equitable and would be in the interest of the investors and the public. The tax of 1-8 of 1 per cent. on the paid up capital on all commercial corporations is, I understand, to be reduced this year, which will be a step in the right direction

OPERATION OF ONE MAN CARS.--Transportation wages is a very large item, hence the operation of one man cars must be of special interest to small companies. A few months ago we followed the example set by some small systems in the United States and put in operation three one man cars. These were not specially built. We used our ordinary single truck cars and closed permanently one door at each end, the other doors are opened and closed by a movable handle. Then changing ends the door is closed and handle removed thereby, preventing passengers boarding or alighting unknown to the motorman. The ordinary steps were removed and replaced with folding steps, one at each door. When the motorman changes the trolley at the terminus he folds up the step, which is held up with a catch. The cars are equipped with push buttons and stop at the near side of intersecting streets. With a car arranged as above it is impossible for passengers to board or alight without being in full view of the motorman. On practically all cars we use the prepayment plan in collecting fares. The business of the lines on which these cars are operated is limited, but we have found that the headway has been as usual and generally speaking the service has been satisfactory. Naturally we have had a few complaints from the public, but in making such radical changes, this was to be expected. The change, however, has enabled us to reduce car expenditure and has also enabled us to increase the pay of the men operating the cars. The necessity for a better margin of return on small properties is recognized and if the one man car system can be successfully worked out it will be a boon to the small companies.

ELECTRIC RAILWAY TRACK CONSTRUCTION.

By R. M. Hannaford, acting Chief Engineer, Montreal Tramways Company.

In the spring of the year in Eastern Canada, and during some parts of the winter, the electric tramway companies are confronted with a serious problem in the handling of water which finds its way to the tracks. The tramway tracks, being in the centre of the street, should be the highest elevation of the roadway, but unfortunately this is not always the fact Levels may be obtained from the city engineers, and although they are followed strictly, the city is liable to come along in a year or so and grade

the sides of the street, all the way from 2 to 6 in. higher than the rails. This leaves the rails in a pocket, even in summer, and one does not need much imagination to picture the case in winter, where there is from 6 to 9 in. of snow and ice over the roadway. When the street is paved the company is asked to lift its tracks to conform to the new level of roadway, and if paving was always put to theoretical section the levels would be as good as could be expected when put in by somebody who has not to maintain the track.

The city engineer generally carries the paving on the roadway too flat in the centre and it does not fall away, in level, at a proper curve from the outside rail of the track, in fact in some cases it has been found that new pavement when installed, was found to be 2 ins. higher than the rails at a point 4 ft. from the rails, thus leaving the rails in a pocket. Usually, in the paving between tracks, the blocks are carried to a crown of from 1 to 2 ins., this keeps water running down the rails or lying on them in the track on a mild day in winter. The trackmen, in their endeavour to get water away from the track, dig ditches through the ice at the side of the roadway to the gullies, tapering the cut well down on each side, so as to interfere as little as possible with vehicular traffic, the water melts away the ice and widens the sides of the cut, and in a few hours the cut has become almost dangerous to traffic, on account of its steep sides. A method of laying blocks between the tracks can be used as shown in diagram, which will obviate this state of affairs, and by dishing the blocks, instead of crowning them, water will be led down the depression in the blocks in the centre, instead of at the rails, and instead of water being allowed to soak down between the rail and the blocks it will be carried by the depression between the rails and away from the rail itself. Suitable catch basins can be installed at all changes of grades, or at stated intervals, and water led to sewers by keeping water from the rail. Discomfort to the travelling public, and delays to cars will thus be avoided and tracks will be kept in better surface. Paving will not require resetting as often as at present, pedestrians will not be splashed with water, and crossing tracks at street corners will be facilitated, as it is at corners of streets where changes of grade usually occur. As to the difference of level in street, in regard to vehicular traffic, by depressing blocks between tracks, there should be no more obstruction to the free passage of vehicles, than if an ordinary crown between tracks was used, in fact the passage of a vehicle should be facilitated by depressing the blocks rather than raising them. It would be of no advantage to depress the blocks in the devil strips, but rather would be a detriment as water from the strip would be better looked after by being carried down between rails, and the grade of the street improved for the crossing of vehicles by being crowned instead of depressed.

The catch basin which is proposed is one which it is thought will meet conditions better than the cast iron gulley which is at present in use by the Montreal Tramways Co. In the present one, which is trapped, the difficulty of cleaning out is very great, in fact in winter it is almost impossible. By use of the track basin and grating, made of concrete sides and base, with standard cast iron top, we have a catch basin capable of being used at all times and in which the operation of cleaning is reduced to a minimum. Standard concrete forms can be used to make concrete work, and these concrete gullies should be installed when concrete slab is being placed under track. If necessary these could be installed in track where paving is arched instead of depressed and at any time, even after tracks are laid. The 6 in. outlet connection to sewer is placed 10 ins. above bottom of basin, to allow of settlement of street deposits, and the basin could be cleaned twice a year, which should be sufficient to keep it clear at all times. The paving on this class of construction, as well as on all other classes, should be laid a quarter of an inch below the top level of the head of the rail. This is to allow clearance of wheels and make a more lasting pavement, as blocks are liable to work up, and the wheels of cars hitting them, to get loose, and allow moisture to get down between the rails and blocks and freeze and thaw alternately, and

thus loosen the track and paving. In using this method of depressing paving between tracks an additional advantage gained by the street railway company will be the extra clearance of motors, which is a very important factor in ease of travel, and freedom from breakage of gear cases and frames, and should commend itself even if this factor alone were considered. The distance between the gear case and the paving does not seem to grow any less, although the engineer is generally told it is more today than it was a few years ago. Figures are stubborn facts usually, and the clearance of motor cases certainly measures less on the ground today than it did four years ago, and blocks that would have cleared the motor cases a few years ago we find now are in the way and rubbing.

One fact that brings itself before us continually is the delay caused by lack of clearance in curves of intersections, as an example take the intersection of St. Catherine and Windsor Streets, Montreal. When the eastbound Windsor car reaches Windsor St., it proceeds south on Windsor. In going around the curve the car fouls the St. Catherine track and thus delays the westbound St. Catherine car. As cars cannot pass on curves it also prevents the westbound Windsor car from proceeding aroung the curve and thus causes a great deal of delay to cars and also vehicular traffic. This intersection has been given as much clearance as the width of the street between curbs will allow. A remedy could be found for this, but it is mainly in the hands of the city authorities, and would consist of allowing the track to be placed nearer the southwest corner of the streets—and cutting about 4 ft. off the curb at the corner. This ought not to incommode pedestrian traffic to any great extent. The sidewalk on St. Catherine St. is 13 ft. wide and that on Windsor Street is 11 ft., and if the curb was cut, there would still be a clearance of 10 ft. at the corner of the streets. The southwest curve at the corner, instead of starting at a 100 ft. radius switch, would wave a 200 ft. radius switch and continue on a curve of the same radius for 42 degrees, then for a distance of 17 degrees 20 minutes would spiral from 100 ft. radius down to 40 ft. centre radius and thence out to the end of curve in the same ratio. The outer southwest curve would stay as at present. This would allow the free operation of cars around this intersection without any interference at all. Another saving in time could be made by the stopping of Windsor southbound cars on Windsor St., instead of on St. Catherine as at present, and would relieve the passage of cars on St. Catherine Street. This method of providing car clearance is not new and has been well tried at various places, and should be given more prominence than has been the case, and when it is intended to install a new intersection at any point this clearance should be provided if it is at all possible to do so. Unfortunately streets are usually so narrow that it is almost an impossibility to do so at most places. When it is suggested to install an intersection of this kind, that is with car clearance, one is met with the objection that having clearance at one place, and not at all places is dangerous, and that if you allow your men to pass at one point where there is clearance, they will try it at another point where there is no clearance. This argument the writer thinks is wrong and only misleading. If it is known that at an important point, where traffic is congested, anything reasonable could be done to facilitate traffic, one would be acting against the best interests of the public and the company by not doing everything possible to alleviate the congestion of traffic, both vehicular, pedestrian and car.

In reading a paper before the Canadian Street Railway Association in Oct., 1912 Mr. J. D. Evans, then Chief Engineer of the Montreal Tramways Co., spoke of a more flexible foundation for all track construction and gave a drawing showing the class of construction that we were putting in for the City of Westmount on Westmount Boulevard. This has been completed and we believe will hold up well under all traffic conditions. In installing this track, in which the drawing was rigidly followed, the foundation, which consisted for the most part of gravel, was well tamped and levelled. The

concrete slab was laid one track at a time, and sections were laid in 50 ft. blocks with 1 in. spaces between, the slab was allowed to set for at least three days being kept moist during the whole process of setting, track was laid on the slab and ballasted up to grade, with about 1 in. of sand well rammed under the ties. After tracks had been laid for full section, asphalt filler was poured between the transverse sections of the slab and work was commenced on the upper concrete. The lower part of this upper concrete was of the same mixture as the slab namely 1 of cement to 3 of sand, and 5 of 1½ in. broken stone. Sand was raked out between ties, and cementing was started on the upper surface by a gang of men working with a continuous mixer, and before this middle coat was dry the top coat, which was mixed in boxes, at the side, was applied. This mixture consisted of 1 part of cement to 1½ parts of well screened granite. The top was well trowelled and surfaced with special tools, and then marked off in squares. The total cost, including the base concrete, was $12.65 a foot of track, double. Some of the most important items in labor ranked in cost as follows:—

Laying and removing temporary track	.18c per foot.
Excavating macadam, including removal	.68c per cu. yd.
Removing track per lineal foot	.09c
Laying track per lineal foot	.21c
Labour on concrete per cubic yard	1.22c
Grinding joints per joint	.17c

THE RELATIONS OF A SURGEON TO A TRACTION OR RAILWAY COMPANY.

By George S. Rennie, M. D., Surgeon-in-Chief Dominion Power and Transmission Co. Limited, and Toronto, Hamilton & Buffalo Railway Co.

I have to thank Mr. Coleman, of the Dominion Power and Transmission Co., for his kindness in asking and giving me the privilege of making a few remarks at your meeting. He has done me an honor in bringing me face to face with an organization that makes work for a surgeon, if their efforts are not exerted in the proper direction to lessen casualties. So long as cars run, even with the best possible management, there will necessarily be accidents, but these can be minimized, if care is exercised. Not only do the employes of a traction company have to be careful to avoid injuring sensible people, but they in a sense have to look out to avoid hurting careless and unthinking people, who will run into all kinds of reckless danger, as well. A man on a crossing may be deaf and dumb, for all a motor man knows and may not hear the bell, but that is no reason why he should be run down by a car if it can be avoided.

I wish to make a few remarks from a surgeon's standpoint of a railway and traction company, as to the relation of a surgeon to his company, and the prevention of accidents and also the care of the injured. It is to my mind all important that every traction company should have as one of its officers a surgeon, who is responsible for the handling of all the injured and also the sanitary conditions.

If the mileage of the company is great, it will be necessary to have assistant surgeons appointed at different points. The reason that it is necessary for a company to have its own surgeons is that the management may know at once the extent of the injuries, the disposition of the patient's mind as to litigation, and what he expects, and also that the injured may get prompt and careful attention at the hands of the company. Who is better qualified to know and understand the feeling of a patient and that of his friends toward the company than the surgeon?

The surgeon should work hand in hand with the claims agent of the company, informing him at once of the extent of the injuries, the estimated

period of disability, if any permanent results will follow and the friendliness of the patient to or against the company. This should be forwarded to the claims agent on a form at once similar to the one submitted herewith that has a diagram on the back where absolute location of injury may be marked. It is absolutely necessary to run this department on a business basis so that every one injured should at once be seen by a surgeon of the company, for as days pass some small injuries, or none at all, grow into very serious claims.

Look at the story of the Jew, who asked the conductor of a train why the delay was so long, and on being informed that there was a wreck he started to feel himself all over and on being asked what he was doing, he said he did not know until then that he had been in a wreck and fancied that he had strained his back. It is not that any company wishes to evade the responsibility of paying just claims, but they have to be safeguarded against fraudulent claims, and what is so called nervous prostitution of another man's money; and even with the best of care this very often cannot be avoided.

It is not always in the best interest of the company, or for the patient, that the surgeon of the company should attend the injured in every case, as any one who is injured has a right to be his own master, and have whatever doctor he may wish; but it is all important that the company surgeon see the case at the time of the accident and make a report to the company, so that unscrupulous people will not then have the same opportunity to magnify the injuries that perhaps do not exist. It is also advisable to have the patient's own doctor, if he does not attend the case, called in consultation, so that the injured may know he is receiving the best and proper attention and know from him the extent of his injuries. It is also the duty of the surgeon to obtain the patient's confidence and friendliness. It is quite natural for anyone suffering pain to blame someone for carelessness and it is then that the diplomacy of the surgeon will be called upon to place the oil on the troubled water.

It is advisable in all cases of fractures or suspected fractures that an X ray picture be taken of the parts, so that the plate may be filed with the claim papers for reference. This should be done as soon as possible after the accident, as a surgeon of a company does not know how long he will be attending the case, as a large majority of people injured, if they think there is any liability, do not want a company's surgeon to attend the case, consequently, the surgeon on his first visit should gain all the information that is possible for his company.

In a great many cases, as all know, rapid settlements of claims are advisable, for that reason, after knowing if there is any liability or not, having the surgeon's report and attitude of the patient the claims agent is then in a position and should have the power to make a prompt and rapid settlement; not the so called hole in the corner settlement, as so termed in the law courts, but a just settlement with the patient, and his friends as witnesses, and if this is done the release so obtained is not liable to be thrown out in a court.

A great many patients will speak to the surgeon as to the liability, and it is well for him not to mix in a discussion of this kind, or try to influence a settlement, as the release may be broken on the ground of a company officer's influence. It is better to advise the patient that the nicer way of looking into the case is to give the company a chance of settlement and that they should first report to the claims agent before seeking a lawyer. Ninety nine out of a hundred will follow this plan, unless they have been influenced by an ambulance chaser. In this way the claims agent gets an opportunity of having a chat and making a proper and just settlement with the injured. It is also advisable for the claims agent to suggest that the injured get the advice of his own doctor, in consultation with the company surgeon, as to time of disability, and as to any permanent disability, so that

he cannot break the release on the ground that the company surgeon was wrong in his advice at the time of settlement.

The surgeon of a railway or a traction company has a hard position to fill to satisfy every one, as his duties are at least fourfold.

1. He is ushered into a household to see a strange patient and usually under a very unsatisfactory environment. The patient, knowing that the doctor is a servant of the company, as a rule does not want his professional skill, and the injured and his friends are bitter against the company for injuring one of their family. He first of all has to attend to the injured, if he is allowed to do so, and as he is known to be the surgeon of the company he has to exert more care and give more attention than would otherwise be expected, in order to gain the good feeling and friendship of the family. If a poor result follows, he and the company are naturally blamed. If by his carefulness and attention he gains the friendship of the family he is to be congratulated.

2. He has the care of his patient and the result to follow his first duty, and later he has to be absolutely fair to the patient about his disability and as to any permanent injury. So in this case he has in a sense to occupy a dual position, as he, as well as being a company surgeon, is the private surgeon to the patient, who has the right to exact from him his help and just opinion of his case for the future.

3. He is the surgeon of a company, and consequently the company expects from him statements as to the injury, length of disability, permanent disability resulting and all help that can be given the company.

4. Later the case comes to trial, if a settlement is not made, and he has to give evidence for or against the plaintiff, as the case may be, and must do so with fairness to both.

All that can be done in these matters is for a company surgeon to be absolutely fair to all concerned, taking not one side or the other, but acting with fairness to both and neither should expect more.

It is always advisable for any company to have friends, in case of accidents, and friendship that should be courted is the friendship of doctors, as they can easily do an immense amount of good or harm, as the case may be, and in order to keep good friendship with the profession, the company should see that their accounts, when just, are promptly paid and that they are paid proper fees for the services rendered. The surgeons of the company should also be well paid for their professional work and advice, as they are the means very often of saving the company from unnecessary expenditure. If a company surgeon who has had training in accident work is looking after serious injuries he can very often, from his experience, save the company money, by not having limbs and fingers unnecessarily sacrificed, which under proper care could be saved by the good judgment of his services.

EXAMINATION OF EMPLOYES.—It is all important in order to avoid accidents, that all employes in the active service of a traction or other railway company, should first of all be passed as physically fit for duty by the company surgeon. Physically fit employes work for the same wages as physically unfit, so why should unfit employes get work and so endanger lives and the loss of money to the company.

In my examination of employees during the past 15 years for railway service, I have found that practically 22 per cent. of applicants are rejected for some one cause of physical unfitness or the other. This being the case, it should be the duty of every management to only employ men who have been passed by their surgeon. There are 5 per cent. of people color blind for red and green and if this physical defect is not discovered before employment, how can the public be safeguarded against injury and the company against loss of capital. I submit a form of examination for railway employes as used on the Toronto, Hamilton and Buffalo Railway, and also for the Dominion Power & Transmission Co.

It is important the company surgeon be supplied with proper test,

cards, wools, colored lights, charts, etc. so that he may be in a proper position to judge if the applicant has normal vision, hearing, proper color vision etc. These examinations should be carefully carried out and only those physically fit employed. I hold that if a company employed men who were not physically fit they would certainly show liability for any accident that took place by such employes. It should also be an advantage to a company in a court of law if they can show that they have taken extra precaution in the selection of their employes by having them passed by a competent examiner as being physically fit for their duties.

INSTRUCTIONS IN OPERATION ESPECIALLY TO AVOID ACCIDENTS.—Every employe should be properly instructed in the operation of his car, as well as the run that he has to take, and especially disciplined not to be careless in the operation of his car. The greater number of accidents take place with people getting on and off cars while in motion. Would it not be better for a motorman and conductor to know that everything was safe before starting his car, than to start as someone is getting on or off and injuring them, and thus render the company liable; a five cent fare will not replace a $1500 law suit. It is the rush and hurry and carelessness that as a rule make these accidents and there are many, which means a great loss of money to the company. Would it not be better to make a saving for the company, to take more care and more time. If a car is late, with reason, the crew should not be blamed, but should be blamed if they have injured someone by being careless or in too great a hurry. The management should also see that the time for the run is ample so that it can be performed with care to the public and especially at busy hours they should have more time. Of course, with pay-as-you-enter cars this situation is entirely relieved.

The employe should be courteous and painstaking with the public, assisting them in every possible way and especially at a time when anyone is injured. They should show sympathy with the injured, assist him and speak nicely to him, no matter who is to blame. The crew, as we well know, will usually be blamed by the injured and oftimes it has been reported by injured that the conductor and motorman were both drunk. It matters not if the crew is to blame or not, it pays to be polite and civil in assisting the injured at all times and costs nothing. The employe should be cleanly in their appearance, clothes clean, boots clean, clean shaven and of a gentlemanly deportment.

Many and many are the accidents that if a little more care, presence of mind and time were taken, could be avoided. When people are on the roadway near an approaching car one never knows which way they will run and when they are excited may run into danger in place of going the other way. For this reason special care must be taken to avoid an injury. It is all very well after you have struck someone to say they ran into danger, but under excitement people are not themselves, so you must have presence of mind to act for them to avoid an accident.

TRAINING OF EMPLOYES IN FIRST AID.—It is my opinion that it is better and well that all employes should have lectures and be trained in first aid by the company surgeons. If they have such a training they then know what to do for an unfortunate, not only to comfort him and lessen his pain, but also to dress his injuries and at times may be the means of saving his life or a limb. It is well in every centre to take this training up through the St. John Ambulance Association, where employes can take an examination, and, if passed, receive a certificate of qualification and also have a badge to wear on their sleeve showing the public that they have qualified in first aid in this association. An injured person, on seeing one of these badges is pleased to know that the man has a proper knowledge of how to look after his injuries and the public generally should be grateful to know that the company has taken the precaution to have its employes trained properly in first aid work. We all well know that oftimes some trivial accident, if not taken proper care of at the time, develops in a case of a very

serious nature, with very often the loss of a limb or the loss of a life, simply because proper first aid was not available.

Consequently this first aid training is all important not only to give the injured proper treatment at the time, but also very necessary as far as the company is concerned to lessen the time of disability, and to be the means of saving lives and limbs.

FIRST AID EMERGENCY BOXES AND STRETCHERS. — In order to facilitate the best handling and care of the injured, it is very advisable that a railway or a traction company have at their stations and at other outside locations emergency boxes for dressing the injured, and stretchers, so that injured can be properly moved to a hospital or to their own homes. The emergency boxes are very inexpensive and the one that I have to show you is very useful one and the cost is about $5. This box contains practically everything that is required to look after an emergency in a proper scientific way until the case can be seen by a surgeon. The employes of the company being trained in the use of this box can render excellent first aid, and if they should have forgotten what to do they can follow the directions on the inside of the cover of the box. By the intelligent use of this box not only can the patient at once receive relief and care, but lives as well as limbs may be saved, which should be recognized as a great financial saving to the company, as well as relief to the sufferer.

Stretchers are quite necessary to have at suitable places, where they can readily be obtained, for often it happens that accidents occur outside city limits where an ambulance cannot be had, and if a stretcher can be obtained the patient can be moved more easily and with less pain by placing him on the car and taking him to a place where he can be taken to a hospital or his home. This is a saving of time, which is all important, as you can easily understand, that if a man has a serious injury the sooner he is in a hospital, or a proper place for his treatment by a competent surgeon, the better will be his chance of recovery. The stretcher here shown is a cheap and useful style.

It is also very advisable to have first aid charts and instructions on first aid framed and hanging in conspicuous places at stations, power house etc., so that employes and others may from time to time read them and if a casualty does occur and they are not sure what to do they can consult them.

What I have stated is all in the prevention and being prepared for accidents. I now come to the care of the injured by the crew at the time. The train dispatcher and the surgeon-in-chief should be at once notified of the accident, so that they may be in a position to deal with the case. If the case is of a very serious nature, after very rapid first aid is given, if in a city the case should be sent as quickly as possible in an ambulance or otherwise to a hospital and the company surgeon notified what has been done. If the case is not so serious, the employe will have more time to use his knowledge of first aid work and if near an emergency box can properly do the dressing. After dressing and disposing of the patient his duties will then devolve with his reports of the injury on the claims agent, and as this belongs to that department, I have no suggestions to make other than to submit a report form used by the Dominion Power and Transmission Co.

It was not my purpose in my remarks to try and give you a talk on the way to give first aid to all kinds of accidents, but I do not think it would be amiss if I were to say a few words on the way to give artificial respiration and the use of an instrument known as the Pulmotor. We all well know that thousands and thousands of times people who appeared from all external signs to be dead, have been brought back to life by the means of artificial respiration, and this, supplemented by the Pulmotor, will work to a better advantage. A good means of artificial respiration is that given by Dr. Sylvester and its usefulness is in cases of electric shock, suffocation from gases or other means, drowning, hanging, etc. This method is exemplified on

the charts so that if employes have forgotten how it is performed, the chart may be consulted.

The way to give artificial respiration was demonstrated and the use and principle of the Pulmotor shown.

TORONTO, HAMILTON AND BUFFALO RAILWAY CO.

SURGEON'S REPORT OF INJURIES.

For the information of the Company's Solicitors and their 'ADVICE' thereon.

GEORGE S. RENNIE, M. D.
Surgeon-in-Chief
Hamilton, Ontario

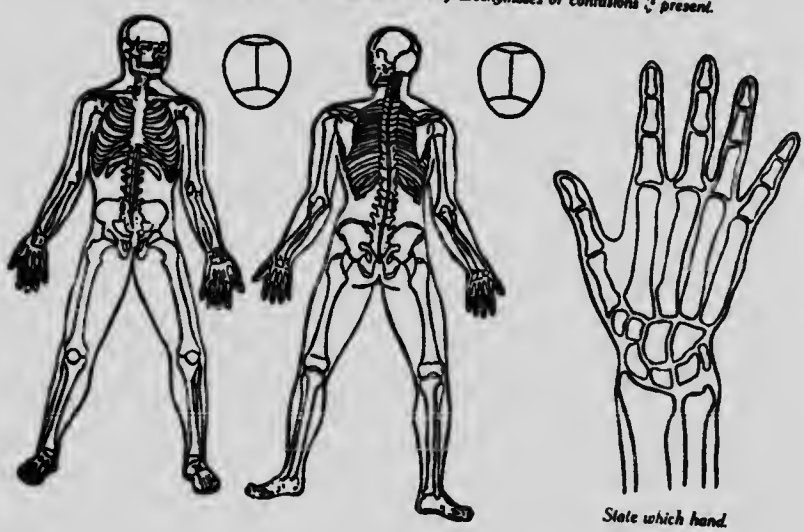
Dear Sir:—In accordance with instructions I send you report in case of,

1. Name..... 2. Age.... 3. Occupation.....
4. Residence..... 5. Date of Accident.....M
6. Place of Accident..... 7. Employed at.....
8. Where was person taken after accident?.....
9. Cause of Accident (full particulars).....
.....
10. Extent of injuries (state fully as possible, mark absolute location on diagram).....
.....
.....
.....
.....
11. Probable length of time disabled?.....
12. What did injured person say as to the cause of the accident?.....
.....
.....
13. Was injured person under influence of liquor?.....
14. Additional Remarks: .....
.....
.....
.....

Date.....191.....

DATE ATTENDANCE REPORTS .....M. D.

Mark exact point of injury. Indicate extent of Ecchymoses or contusions if present.



State which hand.

Surgeon's Examination Report.

1. Name.....
2. Application for employment as.....
3. Residence.....
4. Place of birth..... 5. Age.....
6. Are parents alive?.....Married or Single..... Children.....
7. Height.....feet.....inches..... 8. Weight.....lbs. .....
9. Chest measurement, inspiration.....in., Expiration.....in.
10. What disease or injury has he suffered from?.....
11. Is he ruptured?..... 12. If so, what form?.....
13. Is a suitable truss worn?..... 14. Has he varicose veins?.....
15. When vaccinated?..... 16. Can he read?..... 17. Write?.....
18. Has he any present source of disability in.....
    a. Heart?.....Pulse.....Rate.....Quality.....
    b. Lungs? .....c. Kidneys? .....d. Joints? .....
    e. Feet and legs? .....f. Hands and arms?.....
    g. Has he fits?.....
19. Does he use intoxicating liquors?.....a. Daily amount .....
    b. Has he the appearance of a temperate man?.....
20. VISION.
    a. Number of series in test cards seen at 20 feet distance?.....
       Right eye ..... 20 Left eye ..... 20.....
    b. Least number of inches at which type D-O ..... 5 test type can be read?
       Right eye ..... 15 Left eye 15
    c. Field of vision—good or defective?.....
21. COLOR SENSE.

1. Test skein	Name given	Nos. Selected
Green.....	.....	.....
Pink.....	.....	.....
Red.....	.....	.....

22. HEARING.

Right ear.....	Watch.....	60	Conversation.....	20
Left ear.....	Watch.....	60	Conversation.....	20

23. Lantern Test.....
24. Remarks:

.....

Signature of Applicant
Date of Examination.....

Company's Surgeon.

ELECTRIC RAILWAY SWITCH WORK.

By E. G. Jackson, Sales Manager, Canadian Steel Foundries, Limited.

Of the various departments which go to make up the electric railway of today the most insignificant of all to the average layman is the track department. Ninety nine out of a hundred pedestrians will walk over a large intersection without even glancing at it, much less comprehending the time, labor and money involved in fabricating and installing it. Owing to the space of time at my disposal it is impossible to enter at any great length into the details of the subject to be dealt with, but in order to touch on some of the more important points, I will deal with the subject under two distinct

headings, namely, electric railway intersection work as installed in paved streets, and electric railway, switch and frog work as installed by radial railways when running over their own right of way.

Electric Railway Intersection Work as installed in paved streets, has made as great strides during the last 20 years as car construction, electrical equipment or any other branch of the modern electric railway system. Originallyit was regarded as more or less a product of the repair shop blacksmith, and the first evolution from the above mentioned stage was what is known as built up or bolted construction. This bolted construction consisted of pieces of rail spaced by cast iron fillers held together with bolts. As traffic became greater and cars became heavier, it was found that such construction would not stand up and consequently was not economical. Electric railway engineers and manufacturers therefore, began to look for a type of construction which would be more permanent. The result was the type of intersection work known as insert, or cast construction work. This, as you are aware, consists of pieces of rail held together by means of cast iron, which is poured around the rails, which are of such length as to leave room for the insertion of a cast manganese steel plate or insert at the part of the switch, mate, or frog, which is most subject to extreme wear. There are various methods of securing the manganese steel inserts, the commonest being by means of vertical keys which wedge the insert in place, which keys are in turn held by means of babbit metal poured around same after they are in place. Another method of securing inserts is to cast a lug on them which lug is cored out, to take a key driven horizontally through cored holes in the cast iron, babbit metal being poured around keys in exactly the same way as in the case of the vertical keys.

As it is one of the objects of this paper to draw a comparison between insert work and its more modern rival, solid manganese steel work, let us clearly understand what is meant by the term solid manganese. This type of construction consists of switches, mates, and frogs, being of solid manganese steel from end to end. Each piece is cast from a wooden pattern, the percentage of manganese running from 12 to 15 per cent. It may be interesting to note that after these manganese castings are poured and shaken out of the sand they are extremely hard, but are as brittle as cast iron. Castings after being shaken out are put in a special furnace, where they are heated up to a high temperature and then quenched in a tank of water. This quenching process gives the metal an extreme ductility, without in any way detracting from the original hardness of the casting.

Before drawing comparisons between insert work and solid manganese construction, I might as well state, first as last, that personally, I think solid manganese construction is superior in every way. I would like it clearly understood, however, that when making the comparison, I am dealing with the solid manganese of today, and not with the solid manganese of four or five years ago. Then solid steel had one great and unpardonable fault, namely it crumbled, but during the last three years, I can positively and absolutely say that, through exhaustive and expensive research on the part of the most progressive manufacturers, this defect has been entirely overcome. As a strong advocate of solid manganese construction, I will now endeavor to show the weaknesses of insert work.

1. It is claimed by many that the advantage of insert work is that the insert can be renewed when it is worn out. This argument can only be advanced on insert work where the insert is held in place by means of vertical keys, as I think we will all admit that with the horizontal method of keying it is impossible to remove the insert key without breaking the cast iron body. After having carefully studied the vertical method of keying inserts and observed same under all conditions, I am of opinion that it is impossible to hold an insert tight under heavy traffic with a vertical key, no matter whom the intersection work is manufactured by, and most of you know what trouble

and expense is caused to a track department by continually having to tighten up inserts in intersections.

2. Even if insert work were renewable it is certain that after a number of years wear the rails abutting the insert will be worn down to such an extent that if a new insert is ordered from the manufacturer off the original pattern it is impossible, owing to the wear on the abutting rails, to install same without leaving an extremely rough joint where the new insert joins the rail.

3. It is also important to consider in insert work the effect of the hot iron being poured around the cold rail. It stands to reason that the cold rail must undergo severe crystalization when subjected to the extreme heat of the hot cast iron. From this cause it is only natural that the wearing qualities of the rail are reduced.

4. I think it will be generally admitted that solid manganese construction can be handled far more easily when in shipment from the manufacturer to the railway and also when being installed by the railway; this on account of the difference in weight of the material, also on account of the fact that insert work has to be handled extremely carefully to guard against breakage of the cast iron.

Having outlined some of the objections to insert work, let me now deal with the arguments generally advanced against solid manganese construction. The principal one is on the ground that manganese steel is liable to crumble, but, as previously mentioned, I can say positively that this trouble has been entirely overcome by the best and most reliable manufacturers. Like many other branches of steel manufacture the quality of manganese used for street railway purposes has improved 100 per cent. during the last three years and this fact must not be lost sight of when making comparisons. The next objection which will probably be advanced is in connection with the fish plating of manganese steel intersection work. Up to 18 months ago every leg of a solid manganese piece had to be fitted with a special fish plate, which had to be ground to conform with the inequalities of the manganese. Under such conditions it was a very serious business for a track department to renew fish plates, should they break, as it was necessary to grind each plate and this work naturally entailed carrying the particular fish plate back and forward to the shop grinder. It therefore became necessary for the manufacturer to turn his attention to overcoming this obstacle and, speaking for my own company, I am glad to say that we are now turning out solid manganese pieces 75 per cent. of which will take a standard fish plate. Naturally no manufacturer likes to absolutely guarantee that every joint will take a standard plate, as in the event of one leg of any particular piece not turning out true to section the whole piece would have to be scrapped.

Having touched upon the main points in insert and solid manganese work and having compared the two from a practical standpoint, there only remains the commercial standpoint, in other words, a comparison in prices. Generally speaking solid manganese construction costs very considerably more than insert work. Is it worth it? After careful study of the subject, I am convinced it is more than worth the additional initial cost. The cost of installing an intersection in the street is the same, whether the work is solid manganese or insert work, and the cost of installation is a very heavy item. Consequently if a solid manganese intersection will outwear two insert work intersections, as I am convinced it will, the extra initial outlay on the solid manganese type is more than offset by the difference in the cost of installing a new insert intersection twice, as against the installation of a solid manganese intersection once.

The above comparisons apply to switches, mates, and frogs, also to diamond crossings, and in connection with the latter I would like to touch on the recent desire of electric railway officials to have their solid manganese diamond crossings made in two pieces instead of four. Naturally the idea

presents itself that a two piece diamond is better, because it has only two international joints as against four joints in the four piece diamond crossing. The fact is often lost sight of, however, that manganese steel is an extremely sluggish metal to pour, and if two corners are made in one piece there is a far greater chance of the casting having a latent defect, owing to the metal having such a long way to flow. Consequently a four piece diamond runs a far better chance of being absolutely solid, to say nothing of the advantage derived from having to only replace one corner instead of two, in the event of one corner meeting with any accident.

It may be well at this point to sound a note of warning regarding the danger of an electric railway accepting intersection work as solid manganese steel when in reality it may run anywhere from 2 to 5 per cent. manganese instead of from 12 to 15 per cent. I have seen so called solid manganese work in which the fish plate holes were actually bored. Manganese steel, as it should be made for street railway purposes, cannot be touched by any drill or machine tool, and a little experiment with a cold chisel will quickly determine the hardness of the steel and thereby prove whether the railway is getting what it is paying for. A manganese switch, mate, or frog, should be ground smooth on the running surfaces, but if the piece is finished all over to a smooth surface it is almost certain the metal is not proper manganese steel; the reason being that real manganese is so hard the manufacturer would eat up his profit many times over if he ground each piece all over to a smooth finish.

Before passing on to say a few words on radial railway track work, I would like to draw attention to the design of intersection work as used by the Municipal Tramways of Glasgow, Scotland. I had the pleasure of going over the intersection work in that city not very long ago and a feature that appealed to me strongly was the very narrow groove used in the special work. So narrow is the groove that a car coming over a right angled diamond scarcely made any noise at all, in spite of the fact that in many cases the floor piece at the intersecting points was so low that it did not engage the flange of the wheel at all. The narrow groove is, of course, only possible when a tired car wheel is used, for the reason that if a cast iron wheel were made with the same narrow flange as is used in Glasgow, the flanges would be continually breaking. It might be said that such a narrow sharp flange is dangerous, owing to its tendency to mount the rail, but this does not seem to be the case as the Glasgow cars are on the double deck principle and run at a very high rate of speed in the suburbs. Owing to the narrow groove, the shock transmitted to special work during the passage of a car over an intersection is reduced to a minimum, and thereby, I am convinced, the life of intersection work is increased to a very appreciable extent. I naturally asked the question in Glasgow—what about the extra cost of operating with a tired wheel? and the mechanical department officials assured me it was only a case of having thoroughly up to date equipment to turn up tires and press tires on wheel centres to reduce the cost of operating a tired wheel to the same basis as cast iron wheels. Not being a wheel expert I cannot vouch for the accuracy of this statement, but I do believe, from an intersection work point of view, the tired wheel with the narrow flange is a great factor in reducing wear on special work to a minimum.

Electric radial railway switch and frog work as installed on railways running over their own right of way, is almost indentical with steam railway practice, in that it merely consists of split switches, switch stands, frogs and diamond crossings. Regarding split switches, nothing need be said except that with anything under a no. 7 frog, 10 ft. switch points should be used, with anything over a no. 7 frog, either 15 or 16½ ft switch points should be used.

Regarding switch stands radial railways should follow the practice of the large steam railways of the United States, namely use a rigid stand. Many radials use an automatic switch stand and when purchasing them

few managers appreciate the fact that in using an automatic stand the safety of their cars going over a switch is entirely dependent on a spring. The spring in an automatic stand may be tempered too hard, in which case it breaks, and the switch is lying in any position, and if the spring is tempered too soft it takes a permanent set and the clutches of the stand are not held together in which case the switch point may be lying half an inch away from the stock rail. It may be said there is an advantage in the automatic stand, in that a car can trail through the switch without doing any damage. this in spite of the fact that every motorman has orders not to trail through switch set against him. It simply resolves itself into the proposition of whether the management is willing to depend on a spring for the safety of the cars, and incidentally compromise with a motorman breaking rules, or whether they insist on rules being observed and using a positive rigid switch stand which ensures the safety of their cars if rules are observed.

With regard to frogs, modern practice is to use a rigid manganese frog in terminal work where traffic is heavy, and a spring rail frog on main line high speed work. A special light spring rail frog is manufactured for radial lines and if one considers the rate of speed at which many radial cars go over frogs on the main line, the more will one realize the necessity for the abolition of the rigid frog and the substitution of the spring rail frog.

Regarding diamonds little need be said, except that actual practice has shown that the manganese diamond will outlast at least five built up diamonds, and consequently the additional initial cost cannot be reckoned in when deciding on the solid manganese diamond as against the built up diamond.

SOME PROBLEMS OF INTERURBAN RAILWAY OPERATION IN CANADA.

By Garret Pettingell, Superintendent, Winnipeg, Selkirk & Lake Winnipeg Railway.

Before proceeding with the subject upon which I am expected to reflect some light today, I want to thank the Secretary and committee for according me the honor of presenting a paper at this meeting. There is one point at least on which you will probably agree,—that the committee's judgment may have been at fault in insisting that I present this paper, but as we are not supposed to thaw out in Manitoba until April, our western minds would not be expected to be very active thus early in the season, and therefore, undoubtedly, some consideration will be generously given.

The remarkable development of electric motive power for transportation, and the rapidity with which steam is being replaced by electricity on our railways is bringing the management and different methods of electric operation into prominence. The elasticity of electric power, compared with steam, gives it its greatest value Electric roads are expected to run trains at short intervals with frequent stops, catering in every way to the convenience of the public they serve. Therefore when the operating experience of steam roads is brought into play in planning operating methods for electric railways, managers and superintendents immediately find themselves face to face with new and unexpected problems, never met with under steam operation. Interurban companies are continually drawing upon the steam roads for experienced men, and methods of operation; more especially since electric power is being increasingly applied on lines of considerable length, where trains reach a speed at par with that maintained by their parents in transportation. It must not only be admitted that the interurban officials can learn much from the operating system of steam roads, but it is a fact that this is the only source of information and experience to which they can go when the electric line must graduate from the city street car class into that of a railway. The present system of steam railway operation is the result of the experience of a century, and the methods now in use are the

survival of the fittest. These methods are now at the disposal of the interurban. Nevertheless it is for the managers of the electric lines to determine how far steam methods are desirable in their operation. There is an enormous amount of red tape connected with steam roads that should be at once sidetracked, as far as safety permits, when these rules are to be applied to the operation of electric systems.

THE DISPATCHING OF TRAINS on single track interurban roads disturbs the dreams of the divisional superintendant more than any of his many anxieties. Good commercial operation demands that the dispatching system be conducted as simply as possible, but be effective in handling a given number of cars or trains, running at different rates of speed; the speed to be consistent with safety at all times. The most important safeguard against delay and accident lies in the selection of train crews. There is too much tendency to drift away from the long service and training demanded by steam lines, before placing men in charge of trains; however to meet the summer demand for experienced crews, the employment of young men working their way through college will greatly help to solve this problem. These young men are usually very adept, courteous to the public and of fine appearance. They can be secured each summer for four or five years and are free from college just about the time they are needed most. In seasons where the volume of business is fairly regular, and does not warrant the employment of an exclusive dispatcher, the only safe method of operation would appear to be a strict and vigilant adherence to schedule, operating extra cars, when they are needed, as sections of regular trains or in multiple To operate under verbal orders is unfair to the company, unfair to the men, and dangerous to the public. The maintenance of offices at sub stations and telephone booths at other convenient points, with an exclusive dispatcher whenever business warrants it, is without doubt the only safe method.

Another problem met with in electric operation is a demand that cars stop opposite almost every house to take on or deposit passengers, or possibly receive a dozen eggs for market. All this business should be encouraged in every possible way, but too frequent stops is a matter to be handled very carefully until business is sufficient to warrant the operation of both local and limited cars. In sparsely settled districts, if an average of one stop to the mile is made, and the question put intelligently to the people, they will, in most cases, prefer the better service to the more frequent stops.

The passenger shelter problem is ever present with the average interurban manager, especially in extreme climates where the ordinary roof shelter is not sufficient. The first cost of these conveniences is a heavy item of expense, and it seems to be the experience of nearly every company that they are almost immediately mutilated and made places of nuisance. The most successful way of dealing with this matter, we find, has been to build a limited number, variously scattered along the line, and as the people demonstrate their appreciation of the shelters already built by keeping them respectable, more can be built from time to time, but usually the reverse is the case, which provides the manager with a forcible argument against the building of additional shelters. Of course the company's legal liability in case of exposure resulting from delayed cars must be seriously considered, especially in view of the recent court findings in these cases. However, if cars are operated so close to schedule time that the passengers make a practice of setting their watches by them, very little trouble will be experienced.

MULTIPLE CAR TRAINS.—The multiple unit control of motors of a train has been solved and the multiple car train has passed the experimental stage. It is now up to the passenger agent to make the best use of the advertising to be derived from this source. When the electric enters into competition with the steam road for excursion business, the multiple car train is a necessity, especially wherever the traffic which offers itself for any given time exceeds the capacity of a single car. The running of a train

in two, three or more sections on a single track causes unavoidable and annoying congestion of traffic, increases the danger of accident, as well as the cost of operation, in some cases almost to the prohibitive point. By the use of multiple trains, a crew of three men can take care of an excursion of three or four hundred people with no noticeable congestion.

THE EXPRESS AND FREIGHT BUSINESS afford a very handsome source of income, if properly managed. The public almost invariably expect the interurban lines, when competing with the steam, to provide a very much superior freight service at greatly reduced rates. The reduction of rates is unnecessary, as the people almost at once appreciate the superiority of the service and route their freight by the electric roads. The success or failure of the freight business, of course, depends largely upon the energy of the freight agent, who should keep in close touch with the business men. By having a delayed shipment of package freight rushed forward on the express car to fill a rush order, a new customer is often secured and business thus steadily increased. I have a case in mind where a large business house was almost compelled to have a consignment of canoes sent forward to catch the last boat before the close of navigation. The freight agent was consulted and immediately sent a special car out with this shipment at regular freight rates. The result is that where the interurban was formerly getting only a small percentage of this business, they now get the entire business amounting to thousands of dollars per year.

Every attention should be given the farmers and truck gardeners to encourage them in production and shipment. A call from the freight agent upon these people personally is often productive of splendid results. Then again, the speedy adjustment of freight claims is a great factor in securing new business. The old system of dealing with these claims, by delaying payment, through needless correspondence, until the claimant finally ceases to keep up the fight, will no longer be tolerated by the people. The steam roads have made a marked improvement along this line, but their methods are still a long way from being satisfactory. Customers are expected to pay their freight bills promptly, and they expect prompt adjustment of legitimate claims against the company.

THE CARTAGE PROBLEM. — Some roads follow the practice of giving only warehouse receipt for freight, therefore entailing no expense for cartage, in which case a proportionate reduction in rates can be made. At large commercial centres where the wholesale houses are accustomed to wagon calls, delivery and pick up is necessary to secure the business. As most interurban freight terminals are far removed from the business part of the city and the business consists largely of package freight, the cartage company usually demands from 1 cents to 1½ cents per hundred weight in excess of the usual cartage rate, which of course has to be borne by the company. A strong movement is now on foot among all large transportation companies, both in Canada and the United States, to confine their responsibility to warehousing and transportation on their lines. Let us sincerely hope that this will be brought about speedily, and let us lend all the assistance possible to that end.

It is not the object of this paper to specialize on any particular subject, but rather to bring out the important points of each, in the discussion which I hope will follow.

MODERN TENDENCIES IN RAILWAY CONTROL.

By Clarence Renshaw, Engineer Railway Division, Westinghouse Electric and Manufacturing Co.

In the opening paragraph of his book, "The New Freedom," Woodrow Wilson sums up the industrial conditions of America by the statement "Nothing is done in this country as it was done 20 years ago." It is not improbable that considering things broadly, the same statement will be

almost equally true 20 years hence. To predict the course which conditions in any given line of endeavor will take, over so long a period as 20 years, is of course difficult, but from the experience of the past three years in the control of railway motors, certain modern tendencies can be clearly distinguished.

INCREASING THE INSPECTION MILEAGE. -- Commutating pole motors (and the later types of non commutating pole motors) can be operated for a much greater distance without attention, than can controllers. This is true even on double end cars, where the motors are in use all of the time, while the two controllers divide the work between them. Improvements which will reduce this discrepancy are consequently in great demand in order to strengthen the weakest link of the electrical equipment chain.

GREATER RELIABILITY AND THE ELIMINATION OF ACCIDENTS.—Years of experience and thousands of dollars spent in development, have brought the drum controller, and the circuit breaker used with it, to a remarkable state of perfection considering the difficulties and limitations to be met. But a tiger, even if born and bred in captivity, is not a pleasant associate, and the presence of the drum controller, with its heavy current circuits, on the car platform is still too frequently a source of accidents and of damage claims. The modern tendency is to replace this controller by some substitute located beneath the car.

TRAIN OPERATION.—One of the most difficult problems in conducting transportation is the wide variation in the requirements at different hours. The usual means of attempting to solve this problem has been by the use of trippers and trailers on city lines, and of second, or extra, sections on interurban lines. None of these devices have been entirely satisfactory and the modern tendency is to supersede them by multiple unit trains.

WEAK POINTS OF TRIPPERS AND TRAILERS. -- In most cities of any size, the routing of cars, as a rule, carries a number of lines over a greater or less distance of common track in the business district. Even in the non rush hours, the streets and tracks in this district are crowded and the speed of the cars is lower than on any other part of the line. In the rush hours, such a district usually limits the number of cars which can be operated. The addition of extra cars, increases the congestion and thus reduces the speed through the crowded district. On this account the relief afforded in getting the people home, is by no means proportioned to the number of cars added, and the greater the number of extra cars, the greater is the discrepacy.

A two car train can be moved through the congested district as quickly, as a single car and so the use of additional cars as trailers, instead of trippers not only reduces the cost of platform labor, and the number of extra men necessary, but also reduces the congestion. When the downtown section has been left behind, however, a motor car with a trailer cannot make as good time as a motor car alone, partly on account of the additional stops which it will have to make, to accomodate the larger number of people which it carries, but largely on account of the extra weight of the trailer. By the use of trailers during rush hours, the speed is thus reduced, at the very time when it is most needed. With two cars arranged in a multiple unit train, this latter difficulty is avoided, and, since two motor cars coupled together require less power to operate, and since they attain a higher maximum speed, than if run singly, the use of cars in trains secures a little margin to partly compensate for the greater number of stops. The advantages of two car train operation for city service are very clearly brought out in a paper read by C. J. Franklin, General Superintendent of the Portland, (Oregon) Railway, Light & Power Co. before the American Electric Railway Transportation and Traffic Association, at its 1911 convention. I recommend this paper particularly, to any of you who are especially interested in the subject.

WEAK POINTS OF EXTRA SECTIONS.—On interurban lines, the use of extra trains, or of extra sections of regular trains, running on the same

orders, is of course, sometimes necessary, but it multiplies very largely, the difficulties of safe dispatching. It also requires extra crews, which on small roads are sometimes difficult to arrange for, and it has many disadvantages.

Riding on a "limited," or through car, a couple of months ago, between two cities, which I shall call, A and C, I was very much impressed with some of these general disadvantages. When the car reached the outskirts of B, an intermediate city, 68 miles from C, it was already filled with passengers for C, and when the waiting room in B was reached, the railway officials decided to run a second section. The conductor announced to all those standing, that there would be a second section, in which they could all find seats, but only a few took advantage of the announcement. The majority followed the characteristic American habit of preferring to stand, crowded together on the first car, and grumble at the railway company, rather than to sit comfortably on the second car. The second section followed us closely to the outskirts of B where the motormen and conductors of both cars went to a telephone booth and after some delay obtained the necessary train orders. The car I was on then proceeded.

Had these cars been provided with multiple unit control, the second could have been coupled at once to the first, and since both would run at the same time, the passengers would have divided themselves comfortably between the two cars. Since there would still have been only one train, no additional orders from the dispatcher would have been necessary. With end doors, permitting passage from one car to the next, no additional crew would have been required. The train made only 7 stops in 68 miles, and a single conductor could easily have collected the fares, while a single motorman operated the train. The arrangement would have saved the cost of a train crew for the 2½ hours required for the run from B to C as well as a similar amount for the return of this crew to B. Time would have been saved in receiving orders, as well as at each passing point, and the entire operation would have been more business like, or, perhaps I might say "railway like."

POWER OPERATED CONTROL APPARATUS, of the indirect or multiple unit type, offers many advantages over hand operated drum type controllers, and for reasons such as I have outlined above one of the modern tendencies is towards its more general adoption for all classes of cars. The use of power operated control apparatus permits all main circuits and circuit breaking devices to be removed from the platforms and located beneath the car, thus eliminating a source of numerous damage claims. It enables more powerful and hence more positive and reliable apparatus to be employed, which can be operated for a longer time or a greater distance without attention. It lessens the physical effort required to apply or cut off power from the motors, and thus allows better control of the car. Finally, it enables trains of two or more cars to be operated when required, and affords a valuable means of handling a varying traffic. These advantages would long since have made the use of power operated control universal, and the drum type controller obsolete, had it not been for the complexity and expense of the only power operated control apparatus heretofore available. To overcome this objection and to secure all the advantages of power operated control, while still retaining the simplicity of the drum type controller, type HL unit switch control has been designed. The wide extent to which it is being adopted for city, suburban and interurban equipments of all sizes, bears witness to the success accomplished of this object.

PLAN OF OPERATION OF TYPE HL CONTROL.—In type HL control the various main circuit connections between the trolley, the starting resistance and the motors (which in drum type control, are made by the overhead circuit breaker and the power drum and contact fingers of the controller) are made by a number of independent switches, known as unit switches, each provided with a strong magnetic blowout and normally held open by a powerful spring. Each switch is closed when desired, by compressed,

air acting on a piston, which forces the switch jaws together against the spring pressure. The switches are assembled in a common frame, designated as a "switch group," which is located underneath the car. In large equipments, two of the unit switches are mounted in a separate frame and constitute the "line switch". In addition to their ordinary functions these act as a circuit breaker. In small equipments the line switches are omitted and two of the switches in the group act as the circuit breaker.

The reversing connections which are ordinarily made by the reverse drum of the platform controller, are made by a reverse drum, similar to that of the controller, but of more substantial construction, pneumatically operated and mounted in a separate case underneath the car. The complete everse drum with its operating mechanism is termed a "reverser." Compressed air for operating the switches and the reverser, is obtained from the air brake system, through strainers for removing dirt, and through a reducing valve, set for 70 lbs. pressure. The air is admitted to, or released from, the cylinders, through electrically operated "magnet valves," attached to the cylinders. Power for operating the magnet valves is obtained from he trolley, through a shunt circuit from a control resistance.

The circuits from the various magnet valves are connected to a "master controller" on each car platform, through a "control train line" which extends the entire length of the car and terminates at each end in a 12 conductor "train line receptacle." When the master controller is operated, the control resistance is connected to the trolley and the shunt circuit from it to the various magnet valves, so that, as the controller is moved from notch to notch, the various switches in the switch group are operated, and the proper motor connections are established. If the adjacent train line receptacles on two or more cars are connected by suitable "train line jumpers" the operation of either master controller, on any car, will cause the various switches on all of the cars to close or open simultaneously and train operation will thus be secured.

A car, or train, is operated, by first closing the small overhead "control switch" and then placing the reverse handle of the master controller in the forward, or the reverse position, and moving the main handle from notch to notch, in the same way as if these were the handles of a main drum controller, instead of a small master controller. The main and reverse handles of the master controller are mutually interlocked to prevent improper handling, in the same way as the handles of the usual drum controller.

OVERLOAD PROTECTION is afforded by the line switch, (or by two of the switches in the group when a line switch is not used,) which, in connection with an overload relay mounted as a part of it, acts as a circuit breaker. In case of overload or short circuit, the action of the overload relay will open these switches, and thus cut off power. The function of these switches, however, is not merely that of a circuit breaker, which opens only under overload or short circuit, but also to open every time the handle of the master controller is returned to the off position, so that in addition to opening in case of short circuits, these switches assist in opening the circuit under normal operating conditions. Whenever the overload relay operates, the switches which it opens cannot be closed again until the relay has been "reset" by moving the control switch to the reset position or by manually releasing the necessary latch. The regular operation under normal operating conditions, of the circuit breaking switches, insures that they are always in good working order, ready to open instantly in case of overload or short circuit.

LOW VOLTAGE TRAIN LINE.—One of the many features of type HL equipments is the arrangement of the control resistance. This resistance is not connected in series with the magnet coils, but is connected in shunt across the line, when the master controller is on, and the magnet coils are operated from a low voltage tap on it. Thus, normally, only one of the train line wires carries full trolley voltage, while the remainder are

ubjected to voltages of one third or less, instead of all of the auxiliary circuits being operated at full voltage.

CUTOUT SWITCHES are arranged in a convenient location on the end of the switch group, so that a damaged motor may be quickly cutout of circuit, should this ever become necessary, and the car operated by means of remaining pair. Instead of cutting out both motors of one pair, as is done in drum type controllers, and making it necessary to operate the remaining pair by rheostatic control, the cutout switches are arranged to cut out one motor of each pair, so that series parallel control is still obtained, even with only one pair of motors in use. A four motor equipment with two motors cut out is thus operated exactly like a standard two motor equipment. This arrangement is a great convenience and permits much smoother operation in emergencies.

SWITCH GROUP. — The most important item of the equipment is the switch group. This consists of a skeleton frame, enclosed by removable covers, in which the various switches, each with its cylinder and magnet valve, are assembled. A blow out coil is located at each end of the group and between the various switches [illegible] a way as to produce a particularly effective magnetic blowout, which [illegible]bles the switches to open without damage under heavy overloads and secures long life for the contact tips.

The fundamental parts of the switch group are arranged on the "unit" plan so that any worn or damaged piece may be easily removed and replaced. Thus, for instance, any switch, cylinder and magnet bracket, or blowout coil can be taken out, after removing only two bolts in each case, without disturbing any other parts. The use of compressed air for operating the switches enables powerful forces to be obtained at the switch jaws, for opening and closing them. This forms a most important feature of this group, and an essential advantage of the unit switch system of control. With the type of switch described above, the very powerful spring pressure of 100 lbs. is obtained at the switch jaws for opening them, and a similar force, due to the air pressure in the cylinder, for closing them. This force is not applied, merely as a steady pull, or dead weight, but, as may be seen from the cross section drawing, the means which are employed to obtain a wiping contact when closing the switch, give also a toggle effect when the switch is opened. The heavy pressure for closing the switches insures good contact and excellent carrying capacity, while that for opening them is so great, that freezing, or welding, due to motor flashes, grounds, or short circuits, is unknown, and failure to open is almost impossible.

As a further result of the use of compressed air the force with which the switches operate, is entirely independent of the trolley voltage. As long as the trolley voltage is sufficiently high (200 volts) to operate the magnet valves, which require very little energy and can hence be made to operate successfully over a wide range, the switches close, and remain closed, with the same certainty and power as when the full normal voltage of 600, or more, is available. This fact is of particular importance on roads where low trolley voltages are likely to be met with.

LINE SWITCH.—Practically all of the facts mentioned above with regard to the switch group apply equally well to the line switch, when this is used, since it differs from the group, merely in the number of switches which it contains.

THE REVERSER consists of the necessary number of copper fingers mounted on a stationary base, and pressing upon one, or the other, of two sets of contacts carried on a movable drum. The drum with its contacts is moved to the forward, or to the reverse position, by one, or the other, of two pneumatic cylinders, similar to those in the switch group. Each cylinder is controlled by a magnet valve, also similar to those in the switch group.

Powerful forces, approximating those for operating the switches, are used also for moving the reverser, so that heavy pressures may be used on

the fingers, and firm contact thus secured. The construction gives the reverser large overload capacity, for taking care of momentary current rushes, and makes it impossible for the fingers to become stuck, or welded, due to the motor flashes, short circuits, or other similar troubles.

No springs are used in the reverser cylinder, and the movable drum when pushed to one position by closing the circuit of one of the magnets, remains in that position until the circuit of the other magnet is close. The reverser parts are built upon a cast iron frame and are surrounded and protected by removable sheet iron covers.

EQUIPMENT DETAILS — The various details which supplement the switch group and the reverser, are of the same substantial character. The starting resistance consists of a suitable number of cast iron grids. arranged in two or more frames. The grids comprising each frame are held between sheet steel end plates, by three mica insulated tie rods, arranged at the three points of a triangle. The individual grids are of sufficiently large cross section to give them ample strength, and this, together with the three-point method of support, makes the assembled frames particularly solid and substantial. The entire arrangement produces a set of resistance which is unusually rugged and reliable and at the same time is compact and light.

The master controller, is a small edition of the usual platform controller. The power and reverse handles are mutually interlocked in the usual way. The main switch, is a standard knife switch mounted in a wooden box. It is used to open the circuit from the motors to the trolley, while the control is still connected, so that the latter may be tested, when desired. The main fuse when used is of the magnetic blowout copper ribbon type. The control switch is a small, single pole, double throw, magnetic blowout type switch, used to connect either the control, or the reset circuit, to the trolley. The control resistance is made up of strips of slotted steel ribbon, insulated with mica and enclosed in flattened sheet iron tubes. This arrangement gives an exceptionally substantial and reliabie resistance. The train line junction box is a box containing a small terminal board. It is used to facilitate connections between the train line and the apparatus. This box has an easily opened hinged lid and is one of the many details that have been carefully worked out to make the equipment easy to install and to maintain.

WEIGHT. —For quadruple equipments of 60 h. p. motors, or larger, type HL control is lighter than the required equipment of drum controllers. For smaller equipments, it may be slightly heavier For quadruple equipments of 40 or 50 h. p. motors, however, the difference, whether in favor of, or against type HL, is insignificant, particularly if the weights are compared on the same basis, that is, for single car operation, with the train line receptacles and jumper omitted from the type HL equipment. If the wiring is enclosed in, iron conduit in each case, the difference will probably be in favor of type HL, even on equipments of 40 h. p. motors. I know of one case where a car equipped with such motors and K-35 controllers, was re-equipped with HL control, and showed 200 lbs. less on the scales, after the change was made, than it did before. Even with a difference of this amount against the equipment, however, I feel that it would be no more reasonable to discriminate against it on that account, than it would be to fix a maximum weight limit of 150 lbs., for motormen and conductors.

OPERATING FEATURES.—Some of the reasons which have led to the wide adoption of this form of power operated control, even where train operation was not contemplated, may be briefly stated as follows:—Powerful forces are employed for opening and closing the switches and throwing the reverser so that positive and reliable operation is secured. Heavy pressures are used on the contacts and great capacity for overloads and emergencies thus obtained. These advantages are not subject to the maintenance of a uniform voltage on the trolley. The switches and reverser, operate with

the same positive action with any range in trolley voltage which is likely to be found.

Reliable overload protection is secured, by the use of switches which are regularly operated each time power is thrown on, or off, since this insures that the circuit breaking switches are always maintained in good working order. A magnetic blowout, superior in strength and effectiveness is employed and unusually great circuit breaking capacity thus obtained for the switches. An effective wiping action is provided on the contact tips and this in connection with the powerful blowout, ordinarily eliminates the necessity for filing or trimming the contact tips during their entire life.

The important pieces of apparatus are designed on the "unit" plan and can be readily taken apart for inspection or repair. The apparatus for breaking the circuit, and carrying the power current, is located beneath the car, entirely out of sight of the passengers. Simplicity, accessibility, ruggedness and powerful action are the fundamental principles upon which the entire equipment has been based. The idea that a railway equipment should consist of the fewest and simplest parts possible has been rigidly adhered to and the control apparatus has been reduced to its lowest terms. Delicate automatic devices have been entirely eliminated and all features which tended to complicate former equipments have been rigorously excluded. It is because of these reasons that type HL control has given more all round satisfaction than any apparatus in the previous history of electric railways, and has established new records of reliability and low maintenance cost.

FIELD CONTROL.—In the struggle to maintain a reasonable difference between income and expenses, with fixed rates of fare and increasing prices for labor and material, reducing the power consumption, has been seized upon as an obvious method of economizing. Any means towards this end is given careful consideration. One of the most practical methods of saving power is by the use of field control. In equipments arranged for field control the field windings of the motors are wound with a number of extra turns for use in starting, accelerating and running at slow speeds. On account of these additional turns, the motors when geared for a given maximum speed, are able to develop the tractive effort required for starting and accelerating, with much less current than the usual type. In equipments with this feature, after the starting resistance has all been short circuited in series and in parallel, the extra turns of the field winding are then cut out, and an additional higher speed running notch in series and in parallel thus obtained. Such equipments give the same general effect that would be obtained if it were possible to employ two different sets of gears and pinions on the equipment, and to use the slow speed set for starting and accelerating, and then transfer to the high speed set, after the car was up to speed. By the use of field control, a saving of from 5 per cent. to 10 per cent. in power can as a rule be readily effected. Equipments of any of the common sizes of motors can be supplied with this feature, either with type HL control, or, for the smaller motors, with drum control.

THE 1200 VOLT SYSTEM. — The well recognized economies of higher trolley voltage and the spread of the 1200 volt system have greatly increased the tendency to use power operated control apparatus and multiple unit train operation. The undesirable possibilities of the drum controller for 600 volt equipments, are multiplied many times when the voltage is doubled. At the same time the greater facility with which large amounts of power can be transmitted at the higher voltage, makes train operation more generally applicable. All except a very few of the 1200 volt equipments now in use, employ power operated control. Motors for use on such systems are wound for 600 volts, but insulated for 1200, and connected permanently, two in series for 1200 volt operation. This arrangement is preferable to the use of motors wound directly for 1200 volts on account of the greater weight and the greater difficulty of winding such motors and

because it lends itself better to existing conditions, by permitting full speed operation on 600 volts, when necessary, with the aid of a suitable change-over switch.

CONTROL APPARATUS FOR 1200 VOLTS.— Type HL control apparatus for 1200 volt service embodies all of the inherent features and important characteristics which have made the 600 volt type so eminently successful, and differs essentially only in the use of more switches in series, greater insulation of the current carrying parts from the frame, and better enclosure of the circuit opening parts, to properly confine the more searching high voltage area. Certain additional items in connection with the auxiliary circuits are also required. Instead of being supplied directly from the trolley, as in the case of 600 volt equipments, the lighting and control circuits are usually operated from a dynamotor, which reduces the 1200 volt trolley current, to 600 volts for these circuits. This arrangement permits standard lighting material and standard control circuit details to be retained.

OPERATION AT HALF SPEED ON 600 VOLTS. — Most 1200 volt equipments are required to operate at times on 600 volts, also. To permit such operation all that is necessary is a dynamotor change over switch. By placing this switch in the 600 volt position, the dynamotor is cut out of circuit, and the lights and control circuit supplied directly from the 600 volt trolley. The motors, switches, and resistance remain connected exactly as for 1200 volt operation. With this arrangement, the speed of the motors, is, of course, reduced in approximate proportion to the voltage, so that the maximum speed of the car is only one half as great as when operating on 1200 volts.

OPERATION AT FULL SPEED ON 600 VOLTS. — Since the motors of a 1200 volt equipment differ primarily in insulation, and not in performance, from 600 volt motors it is evident that the motors of a 1200 volt equipment, if connected in parallel instead of in series, and arranged with a starting resistance of the proper value for 600 volt operation, will operate at full speed, and in all other ways, exactly like a standard 600 volt equipment. Where 1200 volt equipments are required to run for long distances on 600 volts they can be arranged by means of a suitable conage over switch, so that the two motors of each pair may be connected in series for 1200 volt operation and in parallel for 600 volts. At the same time each step of the resistance can be connected with its two halves in series or in parallel, and thus adapted for 1200 or 600 volts, the same as the motors. The dynamotor connections can be combined in the same switch so that one movement will effect all of the changes in connections which are necessary in passing from one voltage to the other, and obtaining full speed in each case. An equipment arranged in this way when operating on 1200 volts has the motors connected all four in series, for series operation, and two in series and two in parallel for parallel operation, and when operating on 600 volts, has them connected two in series and two in parallel for series operation, and all in parallel for parallel operation.

DISADVANTAGES OF FULL SPEED OPERATION ON 600 VOLTS. — It will be evident that an equipment arranged for full speed operation on 600 volts is considerably more complicated than one arranged for only half speed, so that unless it is absolutely necessary to obtain full speed for 600 volt operation, equipments should preferably be arranged for half speed only. It is evident, also that certain of the switches must carry twice as much current during the 600 volt operation, with an equipment arranged for full speed, as they do during 1200 volt operation. On certain sizes of equipments this makes little difference, since the switches which are necessary to obtain a strong mechanical construction have sufficient capacity for the 600 volt currents in any case. With certain other sizes, however, this is not true, and larger switches or a greater number of switches, so that some of them may be connected in parallel, are necessary when the equip-

ment is arranged for full speed operation on 600 volts instead of for half speed.

FOUR - MOTOR EQUIPMENTS.—From the fact that the motors are connected permanently two in series, it is obvious that in order to obtain series—parallel control on 1200 volts, it is necessary to have four motors. Practically all 1200 volt equipments are arranged in this way. In one or two special cases, two motor equipments have been used on single cars, with the two motors connected permanently in series, and governed by ordinary rheostatic control. Such equipments, however, are undesirable and are on a par with single motor equipments for 600 volt operation.

DYNAMOTOR COMPRESSOR.— To reduce the weight and complication of high voltage direct current railway equipments, a dynamotor compressor has been developed which combines the functions of the dynamotor and the compressor motor in one machine. The dynamotor part of the equipment runs continuously whether on 1200 or 600 volts, and the compressor is connected to, or disconnected from. it by means of a clutch, regulated by the air pressure governor.

SIMPLIFIED EQUIPMENTS. — While the dynamotor compressor offers many advantages over the use of a separate dynamotor and compressor motor, the presence of the dynamotor element introduces a feature which on small cars, or small roads, it is sometimes desired to eliminate. By using properly designed lighting details instead of the usual 600 volt material, the lighting circuits may be operated directly from the 1200 volt trolley with entire safety. The control circuits of type HL control also require such a small amoun of current, that instead of being operated directly from the line, so that each train line wire is subjected to full trolley voltage, they are operated from a shunt circuit on a resistance, in such a manner that only one wire of the main line is subjected to the full trolley potential while all others operate at a much lower voltage. This arrangement can be readily adopted for operation at 1200 volts, and by using 1200 volt lighting material and a 1200 volt control resistance in this way, the necessity for a dynamotor is entirely avoided. Equipments of this sort may be arranged for operation on 600 volts, either at full speed, or at half speed, in the same general way as equipments using a dynamotor, or dynamotor compressor, and they afford an exceptionally simple and reliable 1200 volt outfit, especially adapted for operating small, or moderate sizes cars, either singly, or in trains of two or three cars.

CONCLUSION.—Summarizing briefly the various points which I have dwelt upon, the principal tendency in the control of railway motors, is towards the use of apparatus, which will give more reliable operation, lower maintenance, and a greater mileage between inspection periods, than the present drum type controller. Bound together with this tendency, is that toward the employment of apparatus which removes the heavy current circuits from the car platform, and permits multiple unit operation. Special efforts are being made to secure economical operation, and the use of field control and the 1200 volt system are two of the tendencies toward accomplishing this end. Fortunately, all of these objects may be secured simultaneously by the use of power operated control apparatus, of which type HL, is the most successful example.

ACCIDENT CLAIMS.

By F. B. Griffith, Claims Agent and Superintendent, Interurban Division, Dominion Power and Transmission Co.

The importance of the claims department in the operating affairs of elcctric railways, both city and interurban, has long been recognized in the industry. One reason of this, and possibly the principal reason, is that it either influences or is influenced by almost every other department that goes to make the organization of a railway company. For this reason,

every department head and, through their respective heads, every employe is interested in the causes and the prevention of accidents and the adjustment of accident claims. Co-operation is essential to the success of every department and nowhere will the principle bear better fruit than when applied in connection with claims matters. Too much importance cannot be placed on campaigns intended to educate the public and the employes of the transportation and maintenance departments along preventative lines. Almost every rule in our operating codes that refers to the movement of cars or trains can be interpreted as a precautionary order against accidents and accident claims, and employes, on entering the service and during their terms of service, cannot be too strongly impressed with this fact. Employes might be divided into three classes:—1st. Those who understand the rules and the significance of them and who live up to them in spirit as well as in fact. 2nd. Those who understand the rules and the significance of them, but who on account of indifference or for the sake of expediency or convenience, will occasionally "take a chance." 3rd Those who pass their training periods and examinations satisfactorily but whose subsequent actions indicate to officials and inspectors thatthey cannot foresee danger or possible danger.

Too much cannot be said in favor of men of the first class. They will generally be found to be proficient in other regulations calling for neatness, promptness, politeness and so forth, but not always, and officials will do well to consider their "safety factor" before getting rid of their services for other reasons. Constant vigilance should at all times be kept to discover men of the second class. The risks or chances they take are generally timed so as to avoid their coming to the knowledge of officials, and it is necessary to appear at unexpected times and places in order to discover them. Their influence on men of the first class is the very worst, especially to newer men in the service. It is not always advisable to dismiss such men on the first appearance of risky practices. A goodly number of men are apt to "run a little fast" and so forth at certain times, but special effort should constantly be made to discover such practices and some action be taken in each case. Constant vigilance will have its influence in this regard. Of men of the third class little need be said. They should be got rid of as soon as they are found out. Otherwise they will get themselves and the company into trouble sooner or later. In spite of all the precautions one can take, however, accidents will happen and the claims department be called into service. It has long been recognized as essential, in the case of accidents, to obtain the names of as many bystanders and eye witnesses as possible. The writer, after several years experience in meeting claimants and adjusting claims, thoroughly concurs in this idea. Witnesses should be interviewed as speedily as possible by a tactful person, and their statements, if possible, written down and signed. The company's physician should be called in the case of every accident where personal injury is involved and his report of injuries immediately forwarded, and, if possible, he should continue in attendance until otherwise directed by the claims department.

The choice of a physician is most important to a company. He should be a man of as high standing in his profession as it is possible to obtain. He is constantly called upon to consult with family physicians of claimants and to give evidence in court regarding injuries and so forth, and his reputation in the medical fraternity and in the community at large cannot be too high. If able to continue in attendance on injured people, he is able to advise on the feelings as well as the injuries of claimants. His tactfulness is also an important factor in his qualifications.

Accidents should be reported to the claims department immediately and promptly followed up with the written reports of the crew, the physician and the witnesses. The claims adjuster should have sufficient knowledge of the law to decide at once the question of liability in ordinary accidents. In the conduct of his work he has every opportunity for the practice of cour-

age, tact, diplomacy and good judgment. In the case of serious accidents, especially when several people are injured and where hospital and transportation arrangements have to be made, it is, of course, necessary to get to the scene of trouble immediately to see that people are comfortably provided for, relatives and friends notified and so forth. This also provides him the opportunity of acquainting himself and ingratiating himself with the injured and their friends. He can decide in such cases whether it is the opportune time to discuss settlements or not.

In the case of accidents where only one person is hurt, and where immediate assistance is unnecessary, other than that rendered by the company's physician and the employe on the spot, the claims adjuster has to decide on the advisability of immediately appearing on the scene. It would in some cases, of course, be impracticable and, in some cases, in the writer's opinion, inadvisable. The time does come, however, when it is necessary to consider and discuss the question of settlement and the best way to go about it, and in this process he has every opportunity of exercising the highest standards of tact, foresight and knowledge of human nature that it is possible for him to develop. He has several kinds of cases to consider and to decide whether liability is obvious, questionable, doubtful or non-existent and to act as best his judgment dictates, chief among which are the following: 1st. Instances where injuries are apt to become worse (either from an imaginary or actual standpoint) before they become better. 2nd. Instances where the injuries are apt to improve quicker than the injured figured on. 3rd. Instances where the extent of injuries can be definitely figured on but where the personal feelings of people are apt to cool down. 4th. Instances where the cost of damage done can be definitely figured on. I refer principally to property damage.

In the matter of accidents where a number of people are injured and liability obvious, it is generally best to approach them and make settlements as speedily as possible. Instances of this kind are generally sensationally reported in the public press and an added importance given them thereby. The injured, however, are apt to know each other, or at least to hear what other are asking for, and to assess their damages accordingly and, taken all in all, these are good cases to "clean up," as a signed release for a reasonable amount has a great tendency to stop further discussion.

In accidents where only one person is injured or where only one person's property has been damaged, and these, of course, comprise the large majority of cases, the adjuster has to decide whether it is best to approach the injured or wait until he is approached by them. In assuming that claimants will make personal application for adjustments, he is taking chances on their placing their claims in solicitors' hands. This is not always the worst thing that could happen, however. Some people are easier to deal with through their solicitors than personally. The person who runs to a solicitor is generally one who has an exaggerated idea of the value of his damages. In waiting for people to make their claims instead of approaching them, the adjuster is also taking chances on the lawyer commonly known as the "ambulance chaser," getting in his work. This phase of the question, however, is not as important here in Canada as it seems to be in certain quarters across the border, and in this community does not need to be considered seriously.

By the foregoing remarks the writer does not in any way wish to belittle the absolute importance of approaching claimants when it is necessary, but I would also suggest the great advantage of having the claimant make the approaches first. In going to him he is very apt to interpret the visit as an act of over anxiety on the part of the adjuster, with the attendant consequences; whereas, in letting him come to you he is out of his own home surroundings and without the moral support of the audience that generally gathers when such interviews take place. In letting or inducing him to come to you, the evidence and the merits of the case can be discussed to far greater

advantage than otherwise, and generally a more reasonable settlement effected.

I have previously referred to the advantage of having the company's physician continue in attendance on injured persons. This should apply even when liability is questionable and I suggest it again here as the best means of maintaining a "line of communication" between the injured and the company, thereby keeping the adjuster informed of the feelings of people as well as of the condition of their injuries. If it is so desired, he is also in the best position to know when the opportune time arrives to suggest to the claimants to call on the company for adjustments, or to advise the adjuster that it is best to make the call himself.

In fixing the limit of amounts to be paid in settlements of accident claims, several matters have to be taken into consideration. The genuineness of the accident itself and of the injuries sustained should be first positively established. Any suggestion of trickery should be thoroughly investigated, and, if evident in any cases, they should not be settled at all but vigorously fought. Cases where liability is non existent and can be clearly proven so should also be fought. Cases where liability is obvious, doubtful or questionable and where the injuries or damages are genuine, should be considered with a reasonably broad view; taking into consideration, of course, that a settlement is a compromise where each must be prepared to give in a little to the other. It should also be borne in mind, however, that law costs are high and verdicts generally higher and that petit juries are as uncertain and sometimes as unfriendly to Corporations as they have ever been.

In closing, I would just comment in a few words in regard to the petit jury system. A few years ago, legislation was passed in Ontario whereby damage actions against municipalities are tried by a judge without a jury. The merits of the question of similar legislation being applied to damage actions against railway corporations, I believe, has been discussed at a previous meeting of this Association. I would submit that it is a good subject for further discussion. I don't profess to know even what hope there would, be of expecting such legislation to be put through, but I think a great deal might be said in favor of it from the standpoint of the railway corporations.

ADJUDICATION OF CLAIMS ARISING FROM INDUSTRIAL ACCIDENTS.

By A. E. Beck, Claims Solicitor, British Columbia Electric Ry. Co.

It is becoming generally recognized that the methods followed by courts are too cumbersome, dilatory, expensive, uncertain and otherwise unsatisfactory for the proper determination of differences between employer and employe concerning compensation for injuries resulting from industrial accidents. Some other tribunal, some other method of meeting the conditions, more direct as to method, speedier as to time and less expensive to all parties interested should be found. Public opinion of today is tending strongly, in lieu of existing legal remedies in such cases, in the direction of settlement of claims of the class referred to by a board of commissioners appointed by the state.

Accidents are inevitable and preventive measures are imperative. In the matter of compensation for injuries received in accidents, it is impracticable to establish any fixed scale which would adequately meet each particular case of personal injury, but compensation laws might prescribe a maximum. Compensation should, however, be to such an amount as is reasonable and proportionate to the injury received, taking into account in the assessment the degree of care and safety afforded by the employer and the negligence of the employe which may have contributed to the accident.

Without entering upon a discussion of the respective merits and demerits of the various state industrial insurance methods the question may well be asked as to why such a board as a court alone, apart from the assessment feature, should not be available for the prompt adjudication of differences between employe and employer arising because of industrial accidents. And, following the subject further, why should not this court adjudicate in a similar manner (especially where the liability is admitted) cases in which third parties, strangers who are not employes, claim compensation in connection with accidents of this class.

Public service corporations, such as electric railways, by reason of their magnitude and responsibility, should not be included in any plan of contribution by groups and classes to a general insurance fund collected by the government. Each corporation of this class in the outlining of any state controlled insurance plan should be liable and responsible only for injuries suffered by its own workman.

Industrial accidents will happen, despite the most complete code of rules and the provision of the best safety appliances known. The man—the human factor ever present in an accident—will forget. But the reparation for the injury received through the compensation of the unfortunate victim of the occurrence is often made burdensome and in some cases ruinous to the employer by existing methods of legal procedure. Consider the case of a thrifty and ambitious mechanic who has with the savings of ten years started a shop of his own and become an employer. Understanding his business thoroughly because of his long training he employs only men who are his equals in skill and experience in operating the machinery of his plant. During the early days of his life struggle he has married and now upon the success of his ventures depends not only his own happiness but also that of his wife and little ones. Early in his career as employer comes his nemesis. A few months after he launches his craft in the field of industry an accident occurs at the plant. Something gives way—someone forgets—but, alas, as the result a workman is rendered sightless. The injured man had not been long at his employment. He had assured his employer that he was familiar with the work and he may have been, as good or even a better workman than his employer. He calls upon his employer for compensation. But can money compensate him? The unfortunate man has been deprived of the means of earning his livelihood. Who will support his wife and little ones? Must he and they be turned to public charity? No, the employer should pay and the court so holds and awards compensation. But according to present methods the claim for compensation must pass, step by step, through a lengthy course, each step taking time and involving costs. What is the result? After a long time the unfortunate victim of the accident receives his award and the young employer, who has just started out in business, finds that the payment of the sum, as well as the heavy costs which the judgment carries, means the ruin of his business. It was asked a moment ago whether the sightless man and his family should be turned over to charity. It may well be asked what is to become of the employer whose business has been ruined because of the unfortunate incident which occurred, although he had done all that forethought and invention could do to avert the accident? What is to become of his wife and little ones, who with him look out on a darkened future because of the ruin of the business of the head of the family?

The object of this paper is to draw attention to the great waste of time and money, in the form of law costs, insurance premiums, etc., which is involved in working out the existing legal remedies for the settlement of compensation for industrial accidents and to suggest a method whereby speedy and inexpensive action on such claims, in a manner fair alike to the industry and the victim of the accident, may be secured. Why would it not be possible for such cases to be heard by a board, organized after the manner of the Board of Railway Commissioners and composed, say, of a lawyer and two laymen, who would, with a simple procedure and in a summary manner,

hear and determine the claims, there being no appeal from their decision except by leave? Would not such a tribunal meet a real need? Why should an employer or employe be dragged through the courts and penalized with unnecessary law costs where the liability for the accident is already admitted. And, with the admission of liability, why should not the scope of this board be such as to cover the case of the stranger who is injured in an industrial accident as well as the workman. A remedy for existing conditions should be found, either through a state industrial board, an adjunct of the Railway Commission, or by amendment of the present method of legal procedure.

Street railway companies have been made a special object of attack by fakers, malingerers and ambulance chasers. Claimants frequently, in cases of undoubted liability, have been known to make exorbitant demands. To illustrate, liability for an accident is admitted, but the claimant and the claim agent differ as to the amount of compensation. The claimant brings an action and the jury (always a jury) awards him $200. Costs go with the judgment and "here's the rub." The costs of the plaintiff in an action in the British Columbia Supreme Court, to which he is entitled to go, would equal the amount awarded. To this must be added the costs of defence by the company, another $200. Here is a total outlay of $600. which the company must now pay. But does the unfortunate victim of the accident receive even the $200 awarded him by the jury? As Peter McArthur says, "I feel like the cat that eat the canary." In addition to the legalized tariff of costs, in itself ample, it is lawful in British Columbia and Manitoba for the lawyer to enter into an agreement with the claimant stipulating for a share of the amount which may be awarded, say one third, yet, although a partner in the litigation, he is not amendable to costs in an unsuccessful action, and his client is usually execution proof. Under such an arrangement what is the result of the case just mentioned? The company pays out $600 in compensation and costs. The unfortunate victim of the accident with his pain and suffering receives $133. And yet the company from the first admitted its liability and only insisted on a fair assessment of difference of opinion was found to exist as to the amount of compensation. It is true that the plaintiff's costs might be reduced by a payment into court by the company, but the proportion of one third to the claimant and two thirds to the lawyers would be maintained.

The protection ordinarily afforded by casualty insurance companies is inadequate and unsatisfactory, usually limited to $1500, and provocative of lawsuits, of which they have the conduct—especially undesirable in the case of employes of any considerable corporation. The casualty company is utterly devoid of sympathy and totally without charity. It engenders discontent and strife between the men as a class and the particular corporation.

By recent press report, the Chief Auditor of the Washington State Industrial Insurance Commission, appearing before the Ontario Workmen's Compensation Commissioner, made a comparison of results between the State and the old liability system as follows:—"Under the old system and legal actions only 20 per cent. of the amount paid by the employers for insurance reached the injured workman. This he divided as follows:—20 per cent. to the agent, 10 per cent. to the head agent, 15 per cent. to office and legal expenses (N. B. No party and party law costs in Washington) and allowing 15 per cent. for profit, fully 60 per cent. of the amount the employer puts in is eaten up and it was estimated that one-half of the judgments recovered by workmen go to the lawyers. Under the Washington Act the workmen actually receive 100 per cent. of the compensation."

From Feb. to Dec. of last year 200 claims for compensation by workmen of the B. C. Electric Railway Co. were allowed, and, during that period of 10 months, only two workmen out of a payroll of over 4000 brought action in the courts. In these cases the claim of one was considered impossible and the other employe made no previous demand. Both actions are now

awaiting trial. The company is unprotected by insurance, and extends liberal treatment to its employes who are injured while in the performance of their duties, to the mutual satisfaction of both parties concerned. The company's policy in this regard is based on the belief that warfare is alike wasteful and destructive to individuals as well as nations.

What is the relation of the government in connection with industrial accidents? As a general principle it may be stated that in such cases the stranger should be placed in the same position as before the accident, while when employer and employe are concerned the question of divided responsibility must be considered. But accidents are an incident of industrial life and the development of industrial life is indispensable to the advancement and growth of the state. In view of this condition, should not the state contribute toward the compensation awarded the victim of the accident? Take the case of street railways, in which we are particularly interested. What industry is of more universal utility? What other form of industrial development does more for the expansion and progress of the community within which it operates? And, with the constant extension of its lines over thoroughfares which are constantly being increasingly crowded, its operation being conducted under most trying conditions, and with the danger of accident being ever present, what form of public service is more worthy of consideration as a fact in the development of the industrial life of the community? Street railway companies cannot shift the burden of accidents on to the passengers, the cost of maintenance and the price of commodities generally may rise and then some, but the street car fare must remain the same.

Has not the state already recognized to a degree its duty in connection with the proper development of industrial life? Are not the large grants which are made from time to time to encourage the advance of agriculture, etc., an acknowledgment of this relation? In the field of railway operation the Dominion Government four years ago established a level crossing fund of $1,000,000 which is administered by the Board of Railway Commissioners to an amount not exceeding $200,000 a year, thus providing financial assistance for carrying out burdensome orders of the commission, for the elimination of grade crossings and promoting the interests of public safety at these points. Is not this legislation an acknowledgment of the government's interest in connection with the liability of railway accidents? Bearing in mind that street railways are industries which operate under regulations established by the state, and are subject to inspection by government officials, would it not be perfectly in order for the principle of the level crossing fund, designed to aid in the reducing of the liability of accident, to be extended by part payment of the award or by establishing courts of compensation in connection with the settlement of claims arising from railway accidents which do occur despite the fact that the government rules were observed and that equipment, etc., were passed by the official inspectors?

The Board of Railway Commissioners now controls generally all matters affecting railways, except damage actions, cases of this character being eliminated from its jurisdiction because it was recognized that owing to their number and varying conditions such control was impracticable. Could not industrial boards, courts of compensation, be created to take up this field of work, the adjudication of all claims arising from industrial accidents by such a body being compulsory? Would not such arbitration courts attain results as fair and just as those now obtained through the present methods of legal procedure and also stay the great waste prevailing under present conditions, giving to the unfortuntae victim of an industrial accident to a greater degree the full measure of compensation to which he is entitled?

UNDERGROUND CABLES.

By W. H. Marsh, Secretary and Manager of Sales, Standard Underground Cable Co. of Canada, Ltd.

The essential elements of any underground cable may be considered to be—1st, the conductor; 2nd, the insulation; 3rd, the sheath.

THE CONDUCTOR.—In any general talk on cables, therefore, a few words on the conductor itself would be first in order. As applied to underground cables, copper has been used almost exclusively for ordinary service as the conductor. The copper comes to the wire rod rolling mill from the refinery in the shape of billets known as wire bars. These are approximately 4½ in. square and 54 in. long, weighing about 250 lbs. each. They are heated and rolled hot to form the so called wire rod, which is then drawn into wire in the cold state, after the oxide has been first removed from the surface of the rod. The wire drawing process consists briefly in drawing it through dies, reducing its diameter and increasing its length by the operation, which process is repeated successively or, as in our case, by "continuous machines" until the requisite size has been reached. For small sized conductors a single wire is used as the conductor, but for the larger sizes (generally larger than No. 4 B & S g.) the conductor is stranded, i, e. composed of a number of wires depending on the size of the conductor, or the flexibility required.

THE INSULATION.—As to the second element of underground cables, namely, the insulation, we find the following principal types in use for various conditions or purposes:—Dry paper, saturated paper, natural fibre, rubber compound, varnished cloth. Dry paper insulation is used in practice only for telephone and telegraph cable.

Saturated fibre has been very extensively used in the past, and gives excellent service when used under proper conditions. It is still being considerably used for fire alarm cables; it having the advantage over rubber, when used for this purpose, of lower electrostatic capacity and greater heat resisting qualities than rubber insulation and has better moisture resisting qualities than dry paper insulation. While power cable is not now regularly manufactured with fibre insulation, we have a sample of such cable that was in use for 24 years, and was still in perfect condition when withdrawn from the ducts.

For power cables, saturated paper, varnished cloth, and rubber compound are all three largely used, while sometimes a combination of different insulating materials is used to form a so called graded insulation. For power cable purposes, saturated paper is used more extensively than any other type, on account of its relative low cost combined with its well known reliability when properly installed and maintained. Its serviceability, however, depends absolutely on the integrity of the sheath, for being hygroscopic, the insulation will absorb moisture from the atmosphere on being exposed, even though it does not actually lie in water. For this reason great care must be taken to exclude all moisture from joints and terminals, driving out any moisture that may have been absorbed from the atmosphere while the ends were necessarily open.

Varnished cloth insulation is very much less hygroscopic than paper insulation. In fact, while not offered as being waterproof in itself without a lead sheath, it is nevertheless sufficiently moisture resisting to be largely used in braided form in relatively dry places,—in fact, it can be actually immersed in water in its non leaded form for a considerable time, without showing any appreciable depreciation in its insulating qualities. In lead covered form, therefore, there is much less likelihood of an appreciable amount of moisture being absorbed at the ends while open for purposes of jointing or terminating. This type of cable is likewise mechanically stronger and less likely to have the insulation injured during installation by cracking, due to bending the cable too sharply.

Of two cables,—the one insulated with paper and the other insulated with varnished cloth,—each properly proportioned to stand the working pressure and the same factory tests, if each is installed by the same installation gang and under the same condition, that insulated with varnished cloth will have the greater factor of safety after installation, for the reason just mentioned that it is less likely to be injured by bending to too sharp a radius, and less likely to absorb moisture while the ends are open, and therefore does not require quite so much skill and expertness in handling and jointing. Varnished cloth insulation likewise has the characteristic of being better able to safely withstand temporary high voltage surges without injury, than either rubber or paper insulation.

Good rubber insulation will withstand moisture to a better extent even than varnished cloth, in fact, a good grade of compound may be permanently immersed in water without deterioration, provided it remains permanently immersed and is not subject to alternate wetting and drying. While a rubber insulated cable may be perfectly moisture resisting so long as the insulation is in good condition, to guard against being attacked by various agents which may be carried along by water which gets into the ducts or manholes, and likewise against deterioration incident to alternate wetting and drying, it must be provided with a lead sheath.

On account of its greater flexibility and practical immunity from absorption of moisture, a rubber lead cable is less likely to be injured during installation than is a paper cable. In general, it may be said that varnished cloth occupies an intermediate position both as to price and moisture resisting quality between paper and rubber insulation. Where conditions are favorable to their use by far the greater proportion of underground cables for power purposes are paper insulated. Where the cable must be frequently opened to make connections (as for instance with distributing mains), it is more customary to use varnished cloth or rubber cables. In the manufacture of paper insulated cables only the best quality of rope paper, free from any deleterious substance, should be used. This is applied in narrow and very thin strips, being wound spirally about the conductor in sufficient number of layers to attain the required thickness (depending on the voltage of which the cable is to be used or the test pressure required). In the case of triplex (or quadruplex) cables, the insulation is usually split, a portion of it being provided in the shape of a belt or jacket over the core of 3 or 4 conductors, after these have been cabled and properly rounded out with jute fillers. After the paper has been applied in this manner, the core so manufactured is carefully dried in drying ovens, and is then saturated with the impregnating compound by means of the vacuum saturating process. From the vacuum tanks the saturated core is fed directly to the lead press before it has opportunity to absorb atmospheric moisture.

Varnished cloth insulation is applied in a somewhat similar way, but in place of being saturated subsequent to having the insulating material applied, all interstices between adjacent overlapping layers are carefully filled as the strips are wound on, by a special viscous non drying compound, so as to completely eliminate all voids.

In the application of rubber insulation the process is quite different, in that the rubber compound (having been mixed of the proper ingredients suitable to meet the requirements of the specifications to which the cable is manufactured) is applied to the conductor in a more or less plastic state, in one or more layers, by means of either the tubing or the horizontal strip machine, forming a dense homogeneous covering of the required thickness. Before the cable is in shape to use to lead cover, the rubber must be carefully and thoroughly vulcanized. The insulation is generally covered with a protecting tape (or braid in the case of non lead covered cables) before it is vulcanized.

THE SHEATH. — After the conductor has been properly insulated with either rubber compound, (and duly vulcanized), paper tape (duly

saturated) or varnished cloth, it must then be lead covered. The lead serves both as a preservative of the insulation, by keeping out deteriorating influences, and likewise as a mechanical protection during and subsequent to installation. Lead cables were laid in the streets of London, Eng., as early as 1744. ("Manual of Telephony"—Preece & Stubbs.") Indeed, the various earlier inventors describe all possible processes of covering cables with lead; by drawing them into place, forming the lead pipe around the cable, by casing the lead spirally or longitudinally and soldering the joints, by drawing down a large lead pipe tightly over the cable, by means of dies or rollers. The scheme of drawing the insulated core into lead pipes was formerly used to a considerable extent. At present the universal method is to form the lead pipe continuously around the finished insulated core by means of a hydraulic lead press similar in construction to that used in making ordinary lead pipe.

CURRENT CARRYING CAPACITY. — The maximum current which a given sized conductor in an underground cable can safely carry, depends entirely on the conditions obtaining,—it being impossible to state the current carrying capacity of the cable independent of the conditions under which this carrying capacity obtains. While the carrying capacity of cables in general is, of course, dependent primarily on the size of the conductor itself, the carrying capacity of a given sized conductor depends on the following conditions. (a) Ability of the insulating material to withstand high temperatures and to conduct heat away from the copper conductor. (b) The initial temperature of the medium surrounding the cable. (c) The ability of the medium surrounding the cable to dissipate heat with small temperature rise. (d) The number of operating cables in close proximity and their relative position. (e) Number of conductors in the cable and their relative position. The ultimate criterion, of course, is that the insulation shall not be heated beyond a temperature considered safe for it, and therefore any condition which tends to increase the temperature of the cable with a given current will by that much cut down the safe carrying capacity of the cable. The highest temperature to which paper insulation or varnished cloth insulation may be heated without danger of deterioration may conservatively be taken as about 150° Fahr. Hence, the current should not exceed that value, which under the conditions obtaining will heat the insulation above 150° Fahr, (if considering paper or varnished cloth insulation).

Increasing the number of conductors under one sheath, the conductors remaining of a given size, would increase the amount of heat per square inch of radiating surface of the sheath generated in the cable if the current per conductor were maintained at the same figure. Hence the cable would become hotter. On this account the greater the number of conductors of a given size under one sheath, the smaller is the current which each conductor may safely carry, other conditions remaining constant. Similarly, increasing the number of cables in adjacent ducts will increase the temperature of the air or medium immediately surrounding the cable, and thereby cut down the maximum safe current which may be carried by each of the cables without raising its temperature above 150° Fahr.

The percentages of the safe carrying capacity of single conductor cables that obtains for cables having more than one conductor, are as follows:—

2 conductor flat or round form	87 per cent.
3 conductor triplex form	75 per cent.
2 conductor concentric form	79 per cent.
3 conductor concentric form	60 per cent.

The following table indicates approximately the percentages of the current which can be safely carried under standard conditions (which are assumed to be represented by four equally loaded cables in adjacent ducts) when the number of cables in adjacent ducts is different from four.

No. of cables.	Percentage of current which may be safely carried by four adjacent cables.
1	120 per cent.
2	110 per cent.
4	100 per cent.
6	92 per cent.
8	84 per cent.
10	79 per cent.
12	75 per cent.

The following table indicates the percentages of current which may be considered safe at different initial temperature, in terms of the current which is considered safe when the initial temperature is 70 degrees Fahr.

Initial temperature.	Percentage of safe current at 70 degrees Fahr.
70 degrees Fahr.	100 per cent.
80 degrees Fahr.	93 per cent.
90 degrees Fahr.	86 per cent.
100 degrees Fahr.	78 per cent.
110 degrees Fahr.	70 per cent.
120 degrees Fahr.	60 per cent.
130 degrees Fahr.	48 per cent.
140 degrees Fahr.	34 per cent.
150 degrees Fahr.	0 per cent.

The following table gives recommended safe current carrying capacity for each of four equally loaded single conductor paper insulated lead covered cables, installed in adjacent ducts in the usual type of conduit system, when the initial temperature does not exceed 70 degrees Fahr., the maximum safe temperature for continuous operation being taken at 150 degrees Fahr.

Size B & S g.	Safe Current in amperes.	Size C. M.	Safe Current in amperes.
14	18	300,000	323
13	21	400,000	390
12	24	500,000	450
11	29	600,000	505
10	33	700,000	558
9	38	800,000	607
8	45	900,000	650
7	53	1,000,000	695
6	64	1,100,000	740
5	76	1,200,000	780
4	91	1,300,000	820
3	108	1,400,000	857
2	125	1,500,000	895
1	146	1,600,000	933
0	168	1,700,000	970
00	195	1,800,000	1010
000	225	1,900,000	1045
0000	260	2,000,000	1085

Rubber insulation cannot safely stand as high a temperature as 150 degrees Fahr., but, on the other hand, rubber is a somewhat better heat conductor than dry or saturated paper, and therefore when applied to the same size conductor, in equal thickness, will permit of a larger current flowing in the conductor for the same temperature rise above the surrounding air. For this reason the carrying capacity of rubber insulated cables under ordinary conditions is not materially different from that of paper insulated cables.

The manufacturer is sometimes asked for statements as to the overload capacity of his cables. A little consideration will show that if a cable has

been continuously carrying a current which will heat it to its maximum safe temperature, then any increase in current will heat it beyond its maximum safe temperature,—that is to say, theoretically there is no overload capacity. To be sure if the increase is but a small amount and the time of but short duration in the aggregate, the deterioration produced will be relatively slight. The more that the maximum safe temperature is exceeded, the less is the aggregate length of time required to show appreciable deterioration of the insulation. For instance, if the insulation should be heated up to 300 degrees Fahr, it would be considerably depreciated in the course of only a few hours.

It is nevertheless possible to so rate cables as to carrying capacity that they will have an overload capacity, and that is by rating them at a figure less than the current which they can safely carry continuously without over heating. Under these conditions the temerature of the cable at the beginning of an overload period will be lower than its maximum safe temperature; it can then be operated for a limited period of time at a current which is greater than it can safely carry continuously, provided this current is carried only for a period of time during which the temperature of the cable does not rise beyond the maximum safe temperature, and that the overload current is at once removed as soon as the maximum safe temperature has been reached. The amount of overload permissible under these conditions depends, first, on the amount by which the initial temperature of the cable is lower than its maximum safe temperature, and second, on the length of time during which the overload obtains.

HYDRO ELECTRIC POWER VERSUS STEAM POWER.

By C. B. King, Manager, London Street Railway Co.

In this paper I shall endeavor to review our investigations of the proposed use of hydro electric power and show why we decided to continue the use of steam rather than in favor of hydro. In 1906, when it became necessary to have some slight additional power, the hydro proposition had been fairly well started and looked as though it might succeed; and in anticipation of being able to use this power and realizing that a storage battery would be of advantage in connection with the use of hydro electric power, it was decided at that time to instal a storage battery. After due investigation it was decided that one of 320 amperes capacity was about the right size for us, and so the installation of a battery of this capacity was made during the summer of 1907. This storage battery has been used simply to steady the load on the engines and has worked very satisfactorily. We figured that by the installation of this battery, we had really increased the capacity of our power plant about 300 horse power as the momentary loads were taken care of by this method.

After several votes and the passage of bylaws, hydro electric power was finally brought to London by Dec. 1, 1910, when it was immediately put into service for street lighting; the old contract for street lighting with the London Electric Co. expiring at that date. We thought that we would then be able to get a proposition from the Hydro Electric Commission, but were unable to do so until well into the summer of 1911. Fortunately our power requirements had not materially increased during these four years so that we had been able to get along with the power available.

When hydro electric power was first voted on, the proposed rates for London were $28 per horse power on a 20 minute peak load basis, but when we finally got a proposition from the Hydro Electric Commission, the rate proposed was $32, which it was claimed also included the capital charges necessary on account of the local distributing plant. In the Commission's proposal, however, it was stated that we were to get the current at 13,000 volts, which did not come through the local distributing plant, so we thought this additional amount should not have been added. This proposal also

specified a 5 minute peak basis; that we should have to pay for three quarters of our maximum peak load whether we used it or not; that if this peak load increased, the minimum was thereafter and for ever likewise increased. After considerable study of this proposition a conference was obtained with the Commission's engineers, at which it was pointed out how impossible such a proposition would be for us, on account of our peak load being caused by holidays and snow storms, which would raise the minimum to be paid for most unreasonably. To overcome this feature it was then proposed that a maximum reserve be decided upon and that peak load over and above this should be paid for at three times the rate. It was also quite clearly shown that even with this modification the $32 rate would be too high as compared with the cost of steam power and so another proposition was made, fixing a flat rate of $30 per horse power or a rate by meter of 5c per kilowatt hour plus $13 per horse power as a service charge. The rates in this proposal were on the maximum one minute daily average; that is, the maximum one minute peak for each day in the month was to be averaged for the month.

Foreseeing that it would be impossible to make any accurate estimate of the cost of hydro electric power without knowing our momentary loads, a Westinghouse graphic recording watt meter was installed in May 1910, so that we were able to get a full year's records commencing June 1, 1910, on which to base our calculations.

Having obtained such a year's records and what seemed to be the lowest rates that could be obtained from the Hydro Commission, these charts for each day in the year were gone over and the maximum peaks determined. Several of these determinations were referred to the engineers of the Hydro Commission and approved so that there could be no mistake on this point. The daily readings were then charted by the month, as shown by the prints herewith. When the year's work had been charted in this manner the maximum and minimum were found to be 765 kilowatts d. c. or 1206 h. p., a. c. and 575 kilowatts d. c. or 904 h. p., a. c. respectively. As we were generating d. c. current and would have to convert the 13200 volts alternating current to d. c. it was decided to reduce all the hydro rates to a d. c. basis, thus,—

$30 per h. p., a. c. per year=$3.94¼ per k. w., d. c. per month, which= 13c per k. w., d. c. per day.

$13 per h. p., a. c. per year=$1.708 per k. w., d. c. per month, wh ch= 5.62c per k. w., d. c. per day.

5c per k. w. hr., a. c.=.59c per k. w. hr., d. c.

In making these reductions, it was figured that the grand average efficiency of converting the high voltage alternating current to d. c. current at the switchboard, would be 85 per cent. The Hydro Commission's engineers always contended very strenuously that we were figuring the efficiency of this conversion far too low, they claiming that the efficiency would be around 92 per cent., but I had obtained information from several railway companies which had kept records of such conversion and found the efficiency to range from 80 per cent. to 90 per cent. and decided to work on an 85 per cent. basis. Quite recently, and after we had decided not to use hydro electric power, I had some other business with one of the local hydro electric engineers, when this subject of efficiency of conversion came up in some manner and the hydro engineer recommended figuring on an 80 per cent. basis. I laughingly called his attention to the discrepancy between his opinion and some of the other hydro engineers, when he undoubtedly saw the mistake he had made and became quite confused. He tried to then hedge on his 80 per cent. basis, but finally admitted 85 per cent. would be a fair average.

I may also mention here that soon after taking up the study of this subject I realized that a nominal horse power does not always remain of the same value, especially when carried through several conversions from high voltage a. c. to 500 or 600 volts d. c. I resolved then not to become confused

by making the comparison on a horse power basis, but to work out each month for a full year and make the comparison of total costs for a year. Another advantage of this was that it would embrace all seasonable conditions. After working out each month's cost on both the $30 flat rate and on the semi-meter basis, or $13 per horse power service charge and 5c per kilowatt hour, the cost of the current would have been $29,181.03. It was proposed at that time to instal a converting plant having three 300 k. w. rotary converters, so we figured that the cost of operating such a plant would be $3,590 per annum, including heating. This, added to the above figure, brought the cost under the semi-meter basis, which was slightly the cheaper, to $32,771.03 or 1.18c per kilowatt hour d. c. With inadequate and antiquated machinery, our actual cost during the same period had been only $34,510.80. None of these figures include any capital charges, but do include all operating charges and running repairs.

As the comparison of costs were to be for hydro power as against steam power, expert steam engineers had been engaged to test our steam plant and to point out what economical improvements could be made and what these would amount to. The hydro electric engineers always protested very strenuously to this, claiming it did not give the steam proposition a fair show, but I never could see it that way. The determination of the cost of hydro power was simply a matter of correctly reading the load charts and calculating the result based on the hydro proposition, whereas the costs as they would be with a modern steam plant was certainly a matter for a steam engineering expert to determine. The tests of our plant and the calculations as to what could be done with modern steam machinery were gone over by three different engineers and as they each showed approximately the same results, we feel quite confident that they were correct. These results showed that with such modern machinery we could have operated our plant for, at most, 65 per cent. of what we were then doing it and we believed that it could be operated for 60 per cent., however just for comparison, both the 60 and 65 per cent. were used as will be noted in the tabulated statement appended.

It was estimated that the installation of transformers and rotary converters, three 300 k. w. each, would have cost at least $30,000 and that the modernising of the steam plant would have cost approximately $55,000. In comparing hydro power with steam power this difference was allowed for, by adding to the estimated cost of steam power $2,500; being interest and depreciation at 10 per cent. on the difference of $25,000. Taking the 65 per cent. basis, the safer one, and adding the $2,500, we found the operating cost of steam power would be $24,922.66 or 89c per kilowatt hour d. c. This we believed to be a very safe estimate, as it was verified by information obtained from a number of power plants that were actually producing power at a considerably lower figure. Our calculations as to the cost of hydro power and estimates as to the cost of steam power, showed a difference of $7,848.37 per annum as excessive cost of hydro power, and so I think under these circumstances no one could fairly blame us for declining the use of hydro power. We anticipated that considerable public pressure would be brought to bear upon us to use the hydro power but we felt this too great a difference to pay for such opinion. Every opportunity was given the hydro electric engineers to point out where we were wrong in our estimates but the only points they could bring up were that we had estimated the cost of conversion from a. c. to d. c. as too much and that we had estimated the cost of steam power as too low. They invariably referred to the cost of power by the average steam plant. After discussing the whole subject one day for more than three hours, I remarked, "Well gentlemen, after all that has been said on the subject it still looks to me like there is a difference of approximately $8,000 in favor of the steam proposition," when one of the hydro engineers retorted, "Oh well, I have no confidence in your figures." When I asked him to be more explicit, he referred to our monthly

reports of actual work done, intimating that everything entering into the cost had not been so entered. This was so preposterous that the conference then broke up.

Recognizing that our use of hydro electric power would help out on the whole hydro electric proposition in the City of London, we were really anxious to use the power if it could be brought to a basis of fair comparison with steam power, and as our requirements were not then pressing the improvements of the steam power plant were not proceeded with. When, however, extensions were required last year, with more cars to be put into service, it became necessary to provide more power and the Hydro Commission were again given an opportunity. They then reduced the flat rate to $28 but were not willing to reduce the other onerous conditions, such as the peak load basis. One feature of this peak load basis which I believe I have not mentioned was that the minimum peak to be paid for was never to be less than 60 per cent. of the **momentary peak**. The effect of this is shown on the monthly charts. Another very objectionable feature to the contract was that no adequate reward was to be made for interruptions, they reserving in their contract that interruptions for less than one half hour continuously were not to be considered at all, and that they were not to be liable for interruptions caused by strike, riot, fire, lightning, invasion, explosion, act of God, or the public enemies, or any other cause reasonably beyond their control. I have tried several times to think of some cause of interruption which would not be covered by the above, but have been unable to find it. The contract provided that the railway company was to be penalized as the power factor might fall below 95 per cent., but they made no provision for a credit if the power factor might be maintained above 95 per cent., or if it might be made leading.

During the summer of 1912 a still further effort was made to get the use of hydro power under favorable terms, when the local commission were willing that we should take only part of our requirements and even then on a kind of experimental basis for a short period of time; that is, one to three years, provided we should compensate them for any minimum power which they might have to pay for after we should discontinue, when such minimum had been caused by our peaks, but the Hydro Commission would not stand for this, maintaining that absolutely nothing less than a 10 years contract could be made. Hon. Adam Beck stated that the hydro power scheme was beyond further doubt a success, and that it would continue to be so, with the price continually falling, he intimating that we might expect in the near future a $26 rate, though I might say we never got a definite written proposition to this effect. Feeling by this time that we had negotiated quite sufficiently for hydro power, and realizing that during the summer of 1913 we should certainly need more power, we proceeded with the improvement of our steam plant, but we are not at this time sufficiently far along to give anything as the results.

Most people have smiled incredulously and sometimes sympathetically when I have stated that we could not afford to use hydro electric power, nevertheless I know that our circumstances are somewhat peculiar and that we could really not afford to use it until the cost of hydro power on a peak load basis would get down to $20 per horse power and even then I believe we could beat it a little bit. I found that nearly all the larger companies which were using hydro power, were doing so for only part of their requirements, using their steam plants to provide the peak loads, thus enabling them to use the hydro power to its fullest extent for the greatest proportion of the 24 hours possible. We could not figure this out as satisfactory for us, on account of our smaller size.

As so many people had doubted my statement that we could not afford to use hydro electric power, you may imagine my delight when I learned recently that the London & Lake Erie Ry. Co.'s hydro bill for Jan., 1913, was $1,500 as compared with their cost of producing it by steam power for

the same month a year previous of $1,100 This year they had practically no snow storm work to do in January, whereas the year before they had quite a lot and they also had Sunday service which they did not have this year, so that by every reason the hydro cost this year should have been less than their own cost the year before. I am informed that hydro power on the Galt, Preston & Hespeler St. Ry. is costing them a trifle less per kilowatt hour than it did to produce their own power. In their case they generated alternating current and so their proper comparisons were on an alternating current basis. In other words, they did not have to suffer any comparative loss in converting from a. c. to d. c. Another reason which also helps them in the use of hydro power is that they can do their heaviest freight business during the night, when the passenger car load is off.

The St. Thomas St. Ry., a municipal road, is of course using hydro power, but I do not think they are finding it any cheaper than the power they previously produced, otherwise they would not be increasing their fares, according to an item in our newspapers last March to the effect that the fares were to be increased to 6 and 8 tickets for 25c instead of 8 and 10 as before. It is a little early to expect any information as to the cost of power on the Toronto municipal lines but I am certainly awaiting such information with considerable interest.

THE LONDON STREET RY. CO. POWER COSTS. COMPARING HYDRO PROPOSITION OF APRIL 1, 1911.

Mo.	K. W. Hrs.	Flat Rate $30	Serv. Rate $13 Plus 5c per k. w. hr.,	Cost With New Steam Machinery (65 p. c.)	(60 p. c.)
		1 min. daily Aver. Peak	1 min. daily Aver. Peak	Very safe estimate	Safe estimate
1910					
JUNE	228,595	$ 2,542.30	$ 2,449.98	$ 1,802.47	$ 1,663.82
JULY	227,310	2,436.42	2,396.65	1,936.75	1,788.77
AUG.	216,640	2,393.66	2,315.17	1,778.33	1,639.70
SEPT.	227,144	2,331.71	2,350.28	1,711.36	1,579.72
OCT.	221,550	2,288.76	2,294.36	1,665.93	1,547.02
NOV.	223,285	2,393.07	2,360.14	1,889.93	1,744.55
DEC.	279,134	2,744.46	2,844.84	1,894.99	1,749.22
1911					
JAN.	239,016	2,570.51	2,523.80	2,094.01	1,932.93
FEB.	230,292	2,558.47	2,467.00	1,771.04	1,634.81
MAR.	237,469	2,440.41	2,458.32	1,899.27	1,753.17
APR.	214,090	2,385.21	2,296.47	1,857.93	1,715.01
MAY	229,116	2,476.96	2,424.02	2,120.65	1,957.52
	2,773,641	$29,561.94	$29,181.03	$22,422.66	$20,706.24
		3,590.00	3,590.00	2,500.00	2,500.00
		$33,151.94	$32,771.03	$24,922.66	$23,206.24
			1.18c k. w. hr.	89c k. w. hr.	.83c. k. w. hr.
			Difference in favor of steam	7,848.37	9,564.79
				$32,771.03	$32,771.03

NOTES:—

$30 per h. p., a. c. per yr.=$3.94¼ per k. w., d. c. per mo.=13c (x3=.39c) per k. w., d. c. per day.

$13 per h.p., a.c. per yr.=$1.708 per k.w., d. c. per mo.=5.62c (x316=86c per k. w., d. c. per day.

5c per k. w., hr. per yr.=59c per k. w., hr., d. c. per mo.

$3,950=Operating costs but not including interest and depreciation.

$2,500=Interest at 5 per cent. and depreciation at 5 per cent. on $25,000 which is about the excessive capital cost of a steam plant as compared with a hydro plant.

FREIGHT AND EXPRESS TRAFFIC ON SUBURBAN AND INTER-URBAN RAILWAYS.

By G. E. Waller, General Superintendent of Railways, Dominion Power and Transmission Co., L d.

The question as to what extent this branch of the business pays or can be increased from a profit producing standpoint, is one that is prominent in the minds of most of those on whose shoulders rests the responsibility of managing properties coming under the above heading. By this statement I do not particularly refer to those roads whose original design and whose terminals and equipment are fashioned after the standards of trunk lines and whose promoters gave as much and possibly more importance to the question of freight handling in its various branches as they did to the passenger features.

Most of the electric roads in this country were designed essentially for the passenger carrying trade, and to take care, of course, of the parcel and baggage business that necessarily goes with passenger traffic. Some have taken to the freight and express business as an afterthought; some have had it thrust on them, and some figured at the start on handling a modest amount of package freight, which has since grown in volume beyond all expectations. Industries, which naturally follow the extension and improvement of shipping facilities, have started along the routes, and this condition has introduced the question of carload lots and of interchange arrangements with the steam roads. Local franchises in some instances govern the method in which this traffic has to be handled and in some instances prevent the most practical solution of the problem.

The question in the minds of those who have this problem to solve or who see that they will have it to solve in the future, is to what extent does it pay to handle, develop and encourage it. It envolves serious questions, chief among which are the following:—1. Rates, classes of commodities to be handled and interchange arrangements with connecting roads. 2. Terminal facilities, and additional clerical staff. 3. Increased power house or substation facilities. 4. Increased roadbed, track and siding facilities. 5. Effect on passenger schedules and through this the effect on passenger earnings.

After several years experience solving problems as previously described I am firmly convinced that under reasonably favorable conditions this branch of the industry can be profitably handled without impairing the efficiency of the passenger service, and without abnormal outlay in power, roadbed and track facilities, and would submit the following with regard to how it can be accomplished.

It is, of course, very essential that standard local rates should be maintained, and governed by classifications on a mileage basis, with the usual minimum charge, and through joint traffic on an arbitrary basis of through rates (with a minimum charge on car loads and less than carload shipments) as per approved Canadian Classification.

In the matter of terminal facilities I will refer principally to package (l. c. l.) freight. Electric roads usually use the city streets, and municipal franchises generally prohibit anything except package freight cars entering the city, which fact necessitates the establishment of interchange yards

at the outskirts and thereby automatically assigns the c. l. business to points between interchange yards and the suburbs. Terminal facilities for l. c. l. freight should include as central a location as possible, and cartage facilities in centres of any size, to receive and deliver goods. The latter is most important, as one cannot hope to compete successfully with paralleling roads unless shippers are given the accommodation that they have so long been accustomed to expect from transportation companies.

In connection with the increased staff necessary to freight operation, it has been found that very little is required, except at busy terminals. Station agents are usually capable of taking care of the extra work involved, along with the passenger business.

As regards the additional power facilities required for needs of apparent peak load conditions created by handling comparatively large train units of c. l. freight it would seem to necessitate a large additional outlay in power house, substation and feeder equipment, involving extra capitalization that would otherwise not have to be invested. A careful analysis of the conditions in this regard, however, will indicate that this sometimes is not only an erroneous idea but that with the exercise of reasonable judgment by the operating staff the advent of c. l. freight can generally be made the means of evening out rather than increasing peak load conditions.

To most efficiently handle the passenger traffic of any road, sufficient reserve power apparatus has to be installed and maintained, not only to take care of daily peak load conditions, but also the variation in volume of traffic in the different seasons of the year, and also to provide against break downs. Car load business seldom reaches its maximum during the heaviest passenger traffic seasons, and even when it does it permits of so much elasticity in the hours of handling that it need hardly ever overlap the periods when passenger traffic is at its height. With a reasonable amount of ingenuity in the operating department a splendidly satisfactory condition can be attained.

In connection with roadbed, track and siding facilities to be considered, I would state that here again can the freight feature be made an advantage in justifying expenditures intended to take care of abnormal passenger conditions. I am assuming, of course, that the tracks and bridges are capable of taking care of the weight that c. l. traffic introduces. Grades, the length of sidings and the number of sidings are the elements to be considered here. Abnormal passenger conditions, however, require special provision in the matter of track as well as in the matter of power, and I submit that the argument that applies in the previous paragraph to power should apply here with reference to track.

The effect on passenger schedules rests largely with the efficiency of the operating staff. The number and length of sidings must be sufficient to permit of the proper framing of l. c. l. freight schedules. As little picking up and letting off as possible should be done between sidings and l. c. l., schedules should be laid out so as to take care of what maximum conditions generally call for, as this permits of putting regular freights on employes' time cards, if desired, which will have an additional tendency to reduce delays to passenger trains.

The frequency of freight trains also suggests a point worthy of consideration and in deciding this matter the expediency of competitors' service should form some basis on which to make decisions. Naturally the fewer the freights the less they are apt to interfere with passenger traffic. I am prepared to submit that one l. c. l. and one c. l. service each way on a road daily, if it permits of the receipt and delivery of goods within twelve hours, is good service. It will compare very favorably, I think, with the service rendered by the steam roads.

With regard to the effect on passenger traffic, it is all, or should be all towards increasing the same. Freight and express, of course, must not be allowed to interfere with passenger schedules and with this accomplished

the advent of shipping facilities can have no other effect than stimulating passenger trade.

The report of the transportation and traffic branch of the A. E. R. A. committee on freight and express matters indicates that among a series of questions they asked the different roads of the United States was:—"Does this branch of the business tend to increase or decrease passenger traffic?" To this question the replies were nearly all to the effect that traffic was increased. One or two companies stated that it made no difference to passenger earnings. None stated that it decreased passenger earnings.

In developing this branch of the business you will have the co-operation of all the wholesale and retail merchants and shippers in your respective districts, and objections from very few, these being principally from those living along the routes in city limits and these objections can be reduced to a minimum if freight equipment is maintained in good condition.

Give the whole question careful analysis, before deciding that freight and express business is not a good feature to develop and encourage on suburban and interurban lines.

RESULTS OF TEST OPERATION OF NEW TYPES OF CARS AND DESCRIPTION OF NEW STANDARD CITY CARS, AT VANCOUVER, B. C.

By J. B. Rannie, City Traffic Agent, British Columbia Electric Ry. Co.

Every company connected with this association probably appreciates the importance of having a standard type of car for its lines, and, like Diogenes of old in his search for an honest man, sends forth its transportation officials here and there to investigate the merits of new types in the hope that one may be discovered which will better meet the conditions under which the company operates. During the past year or so these "scouts" of the transportation department have had a busy time. Never before in the history of the electric railway industry have there been within such a short period so many new types of cars, some embodying radical departures from the usual, brought forward for consideration. Although the field of operations of the British Columbia Electric Ry. Co., is located at the extreme western outpost of the Dominion, its officials have during the year been as keen on the scent of a standard city car which would meet its requirements, as any company in the Dominion, its efforts during the period including the delivery of cars of the new types known as "Nearside" and "Stepless Centre Entrance."

In this paper I would briefly note the gradual advance of the new type of car in service on the company's Vancouver lines, and describe somewhat in detail the car now established as a standard for this division. In 1889 the Vancouver lines were served by small single truck cars of the type then in general use, with which we are all familiar. These were gradually replaced by double truck cars or greater length, equipped with four motors. Later the Detroit platform was adopted and cars of this type were used for severel years. In 1908 the pay-as-you-enter system was considered by the company, and a few cars of this type secured. After trial operation over the various lines it was found that this type of car was acceptable to the general public and of benefit from an operating standpoint, and the p. a. y. e. car was approved for the Vancouver lines. The standard car for Vancouver at present, established after examination or practical tests of all types of cars which have been brought forward to this date, is a double truck, single end, semi convertible, prepayment car. Thirty-five cars of this type were purchased from the J. G. Brill Co., during the latter part of 1912 and 15 cars of the same class, but of semi steel construction, were turned out of the company's shops in New Westminster. For 1913 delivery the company

has placed an order for 65 cars of this type with the Preston Car and Coach Co. The general detail of the Brill cars are as follows:—

Length over end sills, 30 ft. 1 in.
Length over vestibule, 41 ft., 6 1-8 in.
Length over bumpers, 42 ft., 7 7-8 in.
Length from vestibule, 4 ft., 6 in.
Length rear vestibule, 6 ft., 11 1-8 in.
Width over side posts, 8 ft., 5 in.
Width over guards, 8 ft., 9 in.
Rail to troiley board, 11 ft., 4 5-8 in.
Rail to step, 16 in.
Step to platform, 14½ in.
Step into car, 9 in.
Centres of trucks, 18 ft., 1 in.
Centre of side posts, 29 in.
Trucks, Brill 27-G. E. 1. 4 ft., 6 in. w. b.
Motors, 4 W. H. 101. B2, 40 H. P.
Air brakes Westinghouse straight air, 10 by 12 cylinder.
Signs, Craighead over end window.
Fender, Watson automatic Type B.
Headlight, Crouse-Hinds, type Z.
Weight of car equipped, 45,900 lbs.
Weight per seat, 1120 lbs.
Weight per total load, 656 lbs.

The tramway regulations of British Columbia now demand that all cars be equipped with double trucks. It is possible for the company to adopt the single end type of car because of its routes being looped at the termini or the provision of Y's at the points.

The cars have roof of the arch type, the sashes going into roof pockets. The frame is of wood, with the sidesills reinforced by 15 in. steel plates, along the upper edge of which is rivetted a steel angle to stiffen the plate. The platforms are supported on steel channel trussed knees. The exterior sheathing on the sides is of sheet steel. The doors and end windows are glazed with wire glass, that at the front end being semi opaque for the benefit of the motorman. The entrance and exit doors slide into bulkhead pockets. The exterior of the car is painted in the company colors, of Pullman green, with cream trimmings.

The interior of the car is finished in polished cherry, the seats being of the slat type and to match the interior finish. The arrangement of seats provides eight pairs of transverse seats located in the forward section of the car. In the front end, opposite the exit door, is a short longitudinal seat accommodating 2 passengers, and at the rear of the car are two longitudinal seats accommodating 4 passengers each. This gives the car a total seating accommodation of 42 persons. The provincial tramway regulations demand that 4 sq. ft. of clear space be allowed for each standing passenger and on this basis additional provision is made for 28 persons. Total accommodation is thus provided for 70 passengers.

Ventilation is provided for the car by means of 8 ventilators of the Brill Eureka 2-300 type. These are placed in the roof, 4 on each side. They are so designed that with the average speed of the wind, at from 9 to 12 miles an hour, the total exhaust will approximate 30,000 cu. ft. an hour.

Passengers enter the car at the rear platform and exits are provided by doors both at the front and rear. The rear platform is approximately 7 ft. long and is equipped with a guide rail to separate incoming and outgoing passengers, the former passing the fare box on their way to the door into the car, located at the far side. The guide rail extends to the near side of this entrance door, the conductor being stationed inside the rail, directly at the centre of the car and opposite the steps provided for exit. In order to accustom passengers to move to the front of the car as far as possible, thus

assisting in the carrying of a full load without crowding at the rear during rush hours, signs are displayed asking persons to leave by the front door. Push buttons, communicating with a buzzer on the rear platform, are placed at each window for notification to the conductor of the passenger's intention to alight. In accordance with the British Columbia tramway regulations both the entrance and exit passages of the rear platfor. are equipped with gates, which are kept closed while the car is in motion. These gates are placed flush with the outer edge of the car step and are an absolute barrier to persons boarding or leaving the platform while the car is in motion. The gates are made of wire mesh and are 5 ft. 1 in. high, there being one pair each for the entrance and exit passages. The gates open outward, the projection from the car being about 12 ins. with the g te fully open. The first Vancouver cars fitted with gates came from the Brill Co., the equipment being arranged so that by the conductor moving a lever, located at the centre of the platform, both pairs of gates swung open. This plan was objectionable, as it is desirable at times to allow passengers to leave without permitting others to board the car and the company is now having gate equipment made which will permit of the conductor opening either the entrance or exit passage independently. Persons leaving the car by the front exit, pass through the sliding door leading to the motorman's vestibule. As soon as the car has stopped, the motorman opens the vestibule door leading to the step, by means of a lever located just above his controller. This lever also operates the front step, which folds up when the door is closed.

In connection with the air brake equipment under the control of the motorman, the car is provided with a conductor's emergency valve, operated by a cord run through the car. This emergency equipment connects the brake cylinder with the main reservoir through a double check valve, until it is bled off by returning the emergency valve to its original positio.. As an experiment some cars have been equipped with the Thompson hand-brake arrangement, which provides for the independent operation of the brakes on each truck from its end of the car, this equipment being entirely independent of the air brake mechanism. Headlights are provided at both front and rear, the latter for use during dark or foggy weather to prevent rear end collisions.

The 15 cars turned out at the company's shops are similar in general to the type above noted, but as they vary somewhat in construction material, a word concerning them may not be amiss. They cars are of semi steel construction, the steel frames being purchased in England, and the material assembled and the cars completed at the company's New Westminster shops. The underframe and platforms are of steel channel and I beams, the space over the trucks being made shallow to give better clearance. The side frames are of T bars, trussed below the window rails, and the roof of the arch type with steel carlines. The sides of the cars are sheathed with 5-8 in. white spruce beaded sheathing, protected near the base by a guard rail of ¾ in. pipe. The over all length of the car is 44½ ft. and its weight, equipped, 43,400 lbs. Its weight per seat is 964 lbs. and per total load 594 lbs. this computation as to weight being of value as showing what can be done with a steel frame car in the line of reducing weight.

The 65 cars ordered from the Preston Car & Coach Co., are of the general standard noted above, one exception being that 20 will be mounted on St. Louis no. 23 E. C. trucks with 5½ ft. wheel base.

Last fall the company purchased from the J. G. Brill Co. a sample car of the "Nearside" type. It is 45 ft. 1 in. long, and similar in every particular to the Philadelphia cars of this style, except that the side plans were reversed to conform to the "keep to the left" rule of the road which prevails in British Columbia. Publicity was given through news items and advertisements concerning the use of the new type of car and it was placed in operation during December. The records of its operation show that it does not maintain schedule time in regular service and the general results obtained are not

such as would lead the company's management to favourably consider the purchase of additional cars of the class. It is possible that the "Nearside" car may be operated with satisfaction to both the public and the company in some cities, the commendations of this type of car given by some companies being very pronounced, but in the B. C. Electric Ry. Co.'s opinion it is not suited to existing conditions in Vancouver. One of the objections to the car came from motormen, arising because of climatic conditions in the form of foggy weather such as prevails in Vancouver during certain seasons. At such times the front window must be kept open, and, with the open car behind, the operator is located in the path of a severe draught.

The company also purchased from the Brill Co. a centre entrance stepless car. This is 44 ft. over all and similar in general to car 5000 of the New York City system, the sides being converse to conform to the B. C. rule of the road, and the ends pointed to give clearance on the curves of the Vancouver lines. The seating accommodation of the car is 51 and the number of standing passengers who can be accommodated under the B. C. rule of 4 sq. ft. for each person standing is very limited. As there was considerable delay in the preparation of this car for operation it has not at the time of this writing been placed in regular service and it is impossible to say whether it will meet with satisfaction under the conditions existing in Vancouver.

The question of a standard car is one which must be considered individually by each company. Different conditions as to climate, methods of routing, character of business, etc., must be considered in reaching a wise decision, and the wide field covered by the membership of this association leaves room for great variation on each of these points. The car which may be a great success in one city may be an absolute failure in another of equal size. The problem before each company is the decision as to a car which will best meet existing operating conditions and properly safeguard the travelling public, due regard being given, of course, to that character known as public opinion—a fickle jade which public service corporations are necessarily bound to consider. In Vancouver we have endeavoured to face the question in this light and we have reached a decision as to a standard car of the type outlined in general in this paper.

Accompanying this paper are photographs showing the exterior view and floor plan of the standard Vancouver car as well as exterior views of the Vancouver "Nearside" and "Stepless Centre Entrance" cars.

THE RENEWAL OF TROLLEYS WITH STEEL WIRE.

By J. B. Woodyatt, Superintendent of Power, Sherbrooke Railway & Power Co.

It became necessary to renew the trolley wire on a three mile line. The trolley was 00 copper, with 0000 copper feeder for half the distance, and 00 copper for the remainder. On account of the large number of short radius curves, the wear on this section of trolley was excessive, so it was decided to replace the copper with steel wire.

The steel was obtained in the form of 3-8 in. wire. Owing to the length of time required to have the steel rolled into suitable lengths it was ordered in stock lengths of about 600 ft. and welded in the shop. It was suspended by mechanical clips on the straight line and 10 in. soldering ears on curves. The ears were bolted to one end of a flat steel bar 16 in. long, the original trolley with its ears bolted to the other end of the steel bar was strung about 12 ins. off centre, to act as an additional feeder, thus permanently tapped in at every span. The steel bar was supported by the span wires through wood strain insulators. The copper trolley on bridge hangers at a subway crossing was replaced by a steel bar ½ x 2 ins. in section, which gives very much superior results. The steel was easily strung, making good suspensions at both the mechanical and soldering ears, its only disadvantage being that it is not as straight as the copper when first put up. The old trolley

appears at much better advantage as an additional feeder than as scrap, the steel will, apparently, greatly outlast the copper under the conditions of service, and as the cost of the steel was only about 10 per cent. that of new copper it would seem that the renewal with steel was an economical one.

TRAINING OF TRANSPORTATION EMPLOYES.

By A. Gaboury, Superintendent, Montreal Tramways Co.

During the last few years the demand of the public for improved facilities in rapid transit and increased luxury of rolling stock, added to the always rising wages of car men and increasing general expenses has put many grey hairs in the head of the operating man, and the problem of how to meet all this increasing expenditure while the humble and non stretchable 5c. piece still remains our base unit of revenue, calls for a close analyzing of conditions and scientific methods of meeting them, that were not dreamt of in the earlier days of our industry.

Possibly one of the most important factors in the handling of electric railway traffic, and one to which the least attention has been paid in the past, is represented by the men on the cars, and we have just begun to recognize this truth and to appreciate what far reaching effects will result from some attention to details in the selection and training of new men. The day when we picked up any man out of a job, put him on a car under a regular man and after a few days expected him to be an experienced car man has gone by, and we now appreciate the fact that not every man is by nature fitted to be on a car, and that it requires something more than the mere desire to wear a showy uniform with brass buttons to make a car man who is capable of making a good use of the large amount of his employer's capital that is represented by a modern car.

The main difficulty in the engaging of new car men is the choosing of the right subject at the start, as most of us have found out by experience that many a man who, on first view, looked a most likely subject has turned out the very reverse, and many a man whom we were inclined to pass over has, by pluck and perseverance, developed qualities that have shown him to be "the right man in the right place"; nevertheless, the successful engaging of new men is peculiarly dependent on the superintendent of employment or other official in charge, and his success in turn depends, to a great extent, on his ability to judge human nature and to select or reject the right or wrong material.

When we have once accepted an applicant our first duty should be to see that he is carefully looked after and properly started out on the right road, and I cannot emphasize too strongly the importance of this point of getting a man started right. The ideas that he gets, and the impressions made on his mind during the first few weeks of his training are indelibly stamped on his memory and as early impressions generally mould a man's future habits, we should be sure that the instructions given him will mould his habits after our own pattern.

To get a new man to understand and realize that he must submit to discipline is the first and most important move in getting him started right and I think we will all agree that it is also the most difficult. A "green man" coming to us from some other line of business, where discipline is practically nil, finds this new and strange to him, and his natural disposition leads him to rebel against it. It is at this time that all the tact and judgment of his instructors are needed to impress on him the need of discipline and to get him to appreciate the why and wherefore of the various rules and regulations. The test of a new man's idea of the need of discipline comes after he has finished his training, is on the list of spare or extra men and has been on the road for some few weeks in charge of a car. At this time, although he is paid at a fair rate of wages, his daily hours of work are so uncertain

that he finds he has a position that is not any better than he can obtain at any time somewhere else, without having to submit to rules and discipline, and discipline under these circumstances depends largely on how strongly the principle of discipline has been impressed upon him during his early training. We should remember that with most men the hope of advancement is the most powerful influence to good work, and we should be quick to take advantage of this, by pointing out to the new men how highly the older men value their positions, and the many advantages they enjoy, and showing also how the old men have no fear of discipline but rather welcome it as a means of keeping the good men in their ranks and the poor men out, and by showing up the pride of the older men in their years of service the new man will most likely stick to his job, in spite of his dislike to rules, in the hope of becoming, in the course of time, one of the old men himself, and from there rising through the different grades of night clerk, depot master, inspector, chief inspector and divisional superintendent to the highest positions in the operating department, especially when a man works for a company where the principle of promotion along these lines has been in force for years.

No hard and fast rules can be laid down for the handling of men, as the problem is varied to each operating man according to his own individuality, and each official must work out his own salvation according to surrounding conditions, but we may, I think, accept as a fundamental truth that every man must feel right towards the management. If a car man does not feel right towards his superiors, how can he then perform his duties in the spirit of his superior's orders, or how can he expect his services to be rated at their full value?

A car man is the direct representative of the company in its dealings with the travelling public; in fact he is the company to a great majority of them, and if a man feels right towards his employers, will he not also feel right towards his employers' patrons and in the end will not this have an incalculable effect on the feelings of the patrons towards the employer? Our efforts then should be directed towards promoting amongst all our men, both new and old, a feeling of confidence in and loyalty to the management of the company and this feeling must not be of a listless, passive variety, but a loyalty that is deep rooted and aggressive.

What is it that makes our car men ready, at all times, to give to a grumbling patron a good explanation of some delay in service; that will make a man jump in and give a helping hand in trouble, whether on duty or not; that will make him telephone his station to offer his assistance in cases of big fires or sudden emergencies. What is it that makes a man take out his sweeper or plow in the winter snow storms, and keeps him at it until the storm is over, whether it be 13 or 24, or 36 hours straight? Is it the money we give them as wages? I think not, it is a feeling of loyalty, a loyalty that cannot be bought by money but can only be built up slowly and carefully from the very beginning by just and fair treatment to men who need to be firmly convinced of the honor and integrity of those in authority over them. One of the first steps in building up this loyalty would be to assure ourselves that all our clerks, inspectors and corner men work in a spirit of absolute fairness towards all men, that they treat everyone in the proper manner and that no favoritism is shown; then, our schedules should be arranged, as far as possible, to enable every man to obtain a fair living, and make them satisfied that they are as well treated by us as they would be elsewhere. In this company, as well as in many others, we go a little further by introducing a system of bonuses, a mutual benefit society and general welfare campaigns.

In choice of runs and hours of duty all men should be accorded their just rights, whether the rule of seniority or capability be followed, and pains should be taken to impress everyone with the idea that the superintendent is not only willing but anxious to give a hearing to any man with a just complaint. At the risk of being called an egotist, I will endeavour to give you a

brief outline of the ideals followed on this question by the company of which I have at present the honor to be superintendent. We have endeavoured to divide the matter into three different phases which may be said to be:— selection, training and following up; and I will try to show you by what methods we follow through these different points.

As to the relative importance of these phases, I believe, myself, that selection should be accorded first place, for the reason that while a properly selected candidate will be responsive to, and will be benefited by a more or less thorough training, a candidate not properly selected will soon show his true calibre, notwithstanding any amount of time and thoroughness you may devote to his training, and I think this fact is being impressed upon us more and more each day. The first and most difficult condition which confronts us in our company is the necessity that every candidate for a position of conductor must speak and write the two official languages of our Province, that is, French and English; this, you will easily understand, has a very limiting effect on the number of candidates eligible for the position and renders the work of our Chief Instructor most delicate and difficult.

Other conditions are mostly similar to those that exist amongst the greater portion of our sister companies as regard to weight, height and age; that is, we require candidates for position of conductor in our company to be between the ages of 21 and 40 years, to be of a height of 5½ ft. and to weigh at least 140 lbs. Applicant for position of motorman must be over 21 and under 40 years, and must measure 5 ft. 8 ins. and weigh at least 155 lbs. Applicants must, as is usual with most companies, furnish several references from previous employers, and particularly from latest employers during the preceding two or three years, which references are always thoroughly investigated and kept as a part of applicant's record. Application forms are furnished on which applicant must write his application in the presence of one of the clerks in the training school department, and printed forms are also used to obtain all particulars from his preceding employers, when references do not cover the ground sufficiently. After this formality is gone through completely to the satisfaction of the Chief Instructor, the candidate is turned over to the office of the Chief Examining Officer for medical examination. As our company inaugurated, in 1903, the Montreal Street Railway Mutual Benefit Association, which was afterwards changed to the Montreal Tramways Company Mutual Benefit Association, all applicants must immediately after their selection pass a medical examinations before the Chief Medical Officer of the Association, not only on eyesight and ear and color test, but also pass a full examination for a $500 insurance policy which is the mortuary benefit of the Association. The applicant must also furnish to the Chief Examining Officer a certificate of vaccination obtained from the officials of the Board of Health Department of the city. This last item is necessitated by requirements of bylaws and regulations of the City of Montreal. After applicant has passed this examination to the satisfaction of the Company's physician, he is directed to the Superintendent's general office, where, on making his deposit of $10, he is furnished immediately with the official cap, training badge, rule book and pliers and screwdrivers if a motorman, and a punch if conductor. Should the student successfully pass his period of training and be finally accepted as transportation employe this training-badge is changed for a regulation badge number.

Then begins the second phase of the business, that is the training. This is where all companies should unite their efforts, as I am sure that most all operating officials will agree with me that, although we are now paying our men today some 10 or 15c. an hour more than we paid them ten years ago, that we are not getting today any better men or better service than we were at that time, and I also feel that we are certainly not receiving 10 or 15c. worth more of energy and efficiency per hour than we were getting in the last decade. Taking this into consideration, that we are not getting as good a service as we were getting, although paying more for same, I think it is

time that we should devise some new features by which we can reduce the amount of money paid through accidents, proportionately to the increased money paid yearly in wages.

After the selection of men has been taken care of in the best way possible and we have obtained what we think are the best and most intelligent subjects, it is at this stage of the game that we must endeavour to make the best employe possible out of the subject selected, and this by a solid course of training, taking proper care not to confuse the student by too much unnecessary knowledge which he will, anyway, gradually learn by experience, and by giving him the lesson gradually as his railway intelligence will allow him to absorb. The most fundamental knowledge that a motorman should have, for instance, is to run his car in such a way as to avoid accidents, although running on schedule time, and this knowledge he should be taught first, and nothing else should be thrown on his mind before it is shown that he begins to understand the handling and use of the different levers that he has in front of him in his cab. While this is going on on the road it might be well to include at the training school, after a few days have elapsed, some simple explanations of the necessity for the different parts of the equipment of a car, as to the why and wherefore that there is a motor, a controller and a trolley on that car, and all this given, not in technical words, but in the manner so well popularized by Popular Mechanics which is written so that you can understand it.

The platform instructors themselves should have a uniform way of teaching others, and this is absolutely necessary, and as soon as it is found out that the platform instructors do not carry out this part of the scheme they should be immediately replaced, otherwise it is quite difficult for a new man to learn to do anything correctly, if teaching is given him in half a dozen different ways by as many different instructors, in which case what usually happens is, that the student being taught the same thing by different men, in different ways, will in all probability, through ignorance, choose the least desirable method and will probably even make this method less desirable, and as he sees that there is no standard way of doing it he chooses the easiest way for himself when left alone, and all this most probably at the expense of the equipment, if not at the expense of the company's money, in paying accident damage claims. At this moment, the new man has had time to read and re read his rule book, and I think a conference at the training school on the subject of rule book would be more effective than if given at the very beginning.

During his first days of training with the platform instructor he has evidently been given pointers on the various rules and regulations of the company and this practical knowledge, added to a few moments of reading here and there, has helped him in learning a good many of his rules. It is certainly not expected that at that moment the new applicant will know all the rules and regulations of the company but it will certainly impress upon him that what he does not know he will have to learn, as he will be made to understand that some further examination will take place further on and before he completes his course of training. The training on the car is kept going on and as the student is picking up more knowledge all the time and is now able to understand more freely the different explanations that he receives, a course of lectures on prevention of accidents would be right in its place. This course, being given by one of the staff of the claims department would certainly have a great effect, as it is in the prevention of accidents, as well as in a good solid training course, that it is expected the man will reduce the accident claims proportionately to the higher wages paid. It is absolutely necessary that this conference also be given by the method of "written so you can understand it" and the claims department expert, or the official giving the conference, must absolutely make up his mind, before beginning, that he is talking to conductors and motormen in the making, and not to professors or lawyers, and all technical terms or other

words difficult for a beginner to understand must be kept out of his talk. These lectures on prevention of accidents should absolutely be given by one closely connected with the claims department or preferably by the Claims Agent himself, in a company where the claims department is operated as a separate department. The claims agent, owing to his constant touch and dealings with accidents and their secrets is, I consider, the one most fitted to do this work. Being in constant touch with claims of all kinds his mind is concentrated on this subject, at all times, and his experiences in this matter would certainly serve as subjects for very interesting lectures on accidents and more specially on the best ways of preventing them.

The greatest efficiency of any organization cannot be reached without the co-operation of its component parts, and of no particular business is this more true than electric railway operation. In these days of specialization it has become necessary to split up the company into various departments and of these departments there are none that should be more closely connected, more firmly interwoven or more deeply interested in each others' welfare than the operating department and the claims department, and co-operation between these two departments and hearty co-operation at that, is a consummation devoutly to be wished for and incidentally to be worked for.

The accident question always looms up big in front of the operating man, and the problem always with him is how to reduce these accidents and how to lessen the amount of damage claims to be paid, and he is glad of the co-operation of the claims department in helping him to reduce this bugbear to a minimum. Through their constant dealings with accidents the claims department's officials are in a good position to critically analyze and to determine the causes of the various accidents that happen and by keeping the operating official fully informed of the results of their investigations, they would help him considerably to keep down the avoidable ones, and to prevent frequent recurrence of accidents of the same nature.

The first point in these accident talks in the training school would be to impress on the student that accidents are liable to happen to any man; that at the moment he least expects it danger lurks around the corner, and to make him realize the truth of that old axiom, "The price of safety is eternal vigilance." He should be seriously warned of the strength and powerfulness of the car he is running and of the great damage it would do in collisions with other vehicles. He should be made to consider himself as guardian and protector, by impressing on him the responsibility of his position and by laying open before nim the disastrous, and perhaps fatal, results of a possible moment's carelessness. He should be taught to treat the company's expensive machine, of which he is in charge, with the same care he would give to his own property. It should be carefully explained to him that accidents will happen through no fault of his, and no blame will be attached to him unless he is plainly at fault. The why and wherefore of accident reports should be clearly explained to him, as one of the most unfortunate traits of all car men is their deep rooted and unreasoning aversion to making an accident report. I am of the opinion that if this aversion to making accident reports could be overcome, a large proportion of the troubles and expense of accident damage claims would be done away with at once. It seems to me that this trouble should be tackled at the root and while the man is still forming his habits, by clearly explaining the use and need of him making a truthful and careful report of any accident at once, and by getting him to understand that an accident report is not his bitterest enemy, but in reality his good friend; as if he is not at fault his report clears him of blame if he makes one, while if he is at fault and does not make one he is sure to be tripped up later on and reminded of the saying "murder will out." In the training school, there should be hanging in prominent view pictures and illustrations of the various kinds of accidents that happen, thus leading the student to ask what he should do to avoid them;

a source of information from which he may possibly draw, some day, in time to avoid an accident of his own.

Our student has now completed his training course; he has put in his road work under the platform instructors; he has learned how to operate a car; how to collect fares and perform thoroughly his other duties; he has learned his rule book and the meaning of the rules; he has attended the course of instructions and the lectures on "prevention of accidents" in the training school; he has passed his examination by the travelling instructor and has been finally passed as o. k. by the Chief Instructor; he has been given some finishing counsel and friendly advice by the Chief Instructor and has been sent to the Superintendent's general office, where he has changed his training badge and received his regular employe's badge, and has been sent to the division at which he is to be stationed as a trained motorman or conductor.

Our student having successfully passed his examination, our interest in him as a trainer is now gone, but is replaced by a, perhaps, deeper interest in him as an employe, which is shown by a system of follow up. During his training period the new man has gone through so many new and strange experiences, and has had so much and so varied instruction given him, that even the best of men is bound to become somewhat uncertain as to what he knows and what he does not know, and it is for this reason that the follow up man has lately sprung into prominence. How many new men, apparently carefree and full of sangfroid, are not, in reality, but are in fear and trembling during their first trials? How many new motormen on their first trips have not had to swallow hard when their car just grazes a vehicle that swung across the track in front of them? How many new conductors have not wanted to quit because their motorman was over running stops and jerking his car because he had a "green" man on the back? I think you will agree that there are not many new men who have not been thoroughly cast down and discouraged, and it is for this reason that they appreciate the follow up method of the travelling instructors and they welcome, as a brother, the Inspector who hops on the car with a cheery "well, sonny, how is it coming?" I consider that the good resulting from some little encouragement like this would more than repay any company for the small extra expense. However, the real idea of the follow up system is to see that our new employes have grasped the main points of their training and that they are assimilating them in good order. Our new men, during their first month on the road, are regularly visited by the travelling instructors and inspectors, who observe their methods and give them a word of commendation if all seems well, and endeavour to nip in the bud any bad habits they may be forming, impressing on the man's mind the idea that he is not forgotten and lost among the crowd, but that he still retains his individuality and is looked upon as a promising factor in the successful operation of the road.

Our new employe is also considered as on probation for 60 or 90 days, during which period he is obliged to attend, in his own time, a series of lectures given weekly, in the training school. These lectures include a thorough resume of the instructions given during training, a course of lectures on the simpler technical points of the equipment and further lectures on the prevention of accidents and rules and regulations, and at the conclusion of these a final written examination is held, on the result of which depends the standing of the new man as a full fledged employe.

We have followed our applicant through the test of selection, through the period of training and through the following up and final examination, and now find him in full uniform, a full fledged employe, a beginner in a calling that demands a man's work, and where ability, energy and grit are needed every minute of every day. And here, I think, we may leave him, with the hope that the trouble and expense taken in his early education may prove to be a fruitful investment and that his services may be long, honorable and profitable to his employers and bring to himself their fitting reward.

THE WORK ORDER SYSTEM AS APPLIED TO ELECTRIC RAILWAY ACCOUNTING.

By G. D. Fearman, Accountant, Dominion Power & Transmission Co., Ltd.

The work order system is designed to authorize any department to proceed with any work, and to keep accurate account of the cost of same. When any head of department consider a certain piece of work necessary, he proceeds to get an estimate of the cost of same, calling on the engineering department if necessary. A requisition is then made out giving all the particulars, including the estimated cost, and this is sent to the general manager's office for approval. If approved, the requisition is then forwarded to the accounting department, where all work orders, giving authority to proceed with the work and account to be charged to, are made out in triplicate, one copy (red), going to the Department which is to do the work, one copy (green) going on file in the accounting department, and the third copy (white) remaining in the book. All orders are numbered, each copy bearing the same number. Upon receipt of the red copy the department interested gets out the necessary requisitions for the material required and gives the number to the foreman who is to have charge of the work, all time and material being charged to the work order number. The number and account to be charged to are both placed on the requisitions and on the workmen's time cards. The total time charged in each pay is put on the pay roll. Requisitions when completed are sent from the purchasing department to the accounting department, to be checked before being entered on the monthly terms. Finally all requisitions and pay rolls are sent to the accounting department and entered in the ledgers and distribution books. A separate record for each work order is kept, giving the items of materials, time, etc. in detail, so that at the end of each month the progress of the work is known and at the end a complete history as to cost, length of time, etc., is on record. These records are very valuable for reference in the future, and also for keeping down excessive expenditure.

Some of the advantages of this system are that it gives the general manager complete knowledge and control of what is necessary to be done, and what is under way, and a fair estimate of the cost before the work is started. It enables the heads of departments and foremen to plan and lay out their work in advance and have the material purchased in good time and their men always at work. It enables everybody to keep a better check on the cost of the work and also insures that time and materials are properly charged. It also gives an accurate accounting of all time and material used and the actual cost of same. The success of this system depends entirely upon the faithful co-operation of all concerned and care must be taken that all time and materials, etc. and also credits, are entered to the proper number. Some employes will consider this a lot of useless red tape, but after the value of the system has been explained we find a hearty endeavor to carry it out. At the first of each year we issue orders covering some of the ordinary, necessary maintenance work during the year.

Copies of the forms used are submitted as follows:—1. Requisition for work order. 2. Work Orders in triplicate, red, green and white. 3. Requisition for material. 4. Time card. 5. Cost sheet

Requisition for Work Order 7½ x 5¼ inches.

Dominion Power & Transmission Co., Limited.

To General Manager: Date, ...19....

Please have issued, Work Order, as follows, to.....

.....

.....

Charge to .....Acct.

Approved.....Estimate. .....

W. O. no. .....

Work Order (in triplicate) 6½ x 7 inches.

Dominion Power & Transmission Co.

Date..... Work Order no. .....

To.....

This order authorizes and directs you to do the following work, charging all labor and material expended to the above number and to.....

.....acct. .....

.....

.....

Signed ..... Manager

When work is completed return this order properly signed to the Manager.

Report here remarks, etc., ...

.....

.....

Date work completed.....Signed.....

Examined and approved.....

Manager.

Requisition for Material 8½ x 5½ inches

To the Storekeeper: Date. .....191 ..

Please furnish the following material and charge to account specified.

Do not write in this space	Quantity	Material Wanted	COST Do not write in this space	S. P.	CHARGE TO Work Order No.	Account

Approved, ...

Manager. Head of Dept.

Time card 8¼ x 4½ inches.

Daily Time Slip.

Date.....191

Order or Account No.	From	To	Time

Total time.....

Name.....

Certified correct.....

Foreman.

Cost sheet 8½ x 10¾

Work order no. ..... Account..... Issued to.....

Date issued.....191... Date completed.....191...

.....

.....

.....

Estimate.....

	Voucher	Description	Wages & expenses	Material	Credits