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Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal, 8500 copies are printed Total circulation for 1906 to date, 345,200 copies, an average of 8219 copies per week.

The Columbus Convention

The Columbus Convention is still in progress as we go to press, and in every way justifies the wisdom of the executive committee in selecting Columbus as the meeting place for 1906. The weather has been very propitious, the exhibition of electric railway apparatus is magnificent, the papers and reports are more numerous and of the highest value, and the attendance has been larger than ever before. Altogether the Columbus Convention is the most successful in the history of the association.

The representatives of the city, who were largely instrumental in securing the convention at Columbus, and the transportation systems of the city have done and are doing everything possible to make the meeting a success and the stay of our delegates in their city agreeable in every way. Through the courtesy of the Columbus Railway & Light Company the badges of the association were honored for transportation on the cars of that company, and many delegates improved the opportunity to inspect the modern system and methods of the company which were so fully described in the last issue of this paper. In addition several of the interurban roads reaching out of Columbus extended special invitations to the delegates and others in attendance to ride free over their lines and judge for themselves the advancements made in interurban railway operation in the neighborhood of Columbus. The hotel accommodations, about which some fears were expressed, were good although somewhat crowded, as was to be expected from the size of the attendance, but considering all the other advantages derived from the meeting in Columbus this feature constituted no real drawback to the pleasure of the convention. There was quite a large attendance of ladies. Automobile parties, golfing and visits to country clubs afforded entertainment for them during the daytime, while some special function in which the men could join was held every evening. All in all, the social features of the convention were as well cared for as at previous meetings of the association, although no interference with the serious portion of the meetings was permitted.

The new organization was put on trial for the first time and worked very smoothly. The large number of papers—much greater than in past years—gave evidence of the thought that had been bestowed upon this feature of the program, while the discussions gave evidence of the interest which their presentation excited. The aggregate length of both papers and discussion, as well as the fact that this paper is being printed before the close of the meetings, will not permit of a final report of all of the conventions in this issue. Our readers will therefore find an account of the meetings of the Engineering Association and of the opening sessions of the American Association in this number, while the remainder of the reports and a detailed account of the exhibits will be reserved until a later issue.

The Convention of the Engineering Association

The Engineering Association succeeded in adding to the reputation it has previously earned for good work accomplished. The papers presented before this association and

the ensuing discussions are worthy of the most careful reading and study. The subjects were well selected and the committee on topics is to be congratulated upon securing authors who were competent to present their subjects so ably. The papers cover a wide range of electric railway engineering, including matters in relation to track, lines and cables, power stations, cars and car equipment. Detailed comment on the individual papers will appear in this and later issues.

The association this year has accomplished much good work through the medium of working committees. The standardization committee in particular has made excellent progress, and while it did not render a final report has accumulated a vast amount of data and information that will be of the greatest value in enabling the committee to formulate its final recommendations regarding uniformity of practice in many engineering matters. At the Columbus Convention plans were outlined for a still broader work through standing committees, and we look for definite and valuable results during the coming year. In this connection we cannot commend too highly to the attention of the managers and executive officers of the member companies the advisability and necessity for encouraging the heads of their engineering departments to take an active interest in this branch of the main association. Co-operation on the part of the individual engineers in the efforts of the association to advance the art of electric railway engineering can not help but redound to the good of the individual companies. The knowledge and experience gained in an honest endeavor to put the shoulder to the wheel and aid in achieving the objects for which the association stands can be measured in dollar-and-cents value to the men and to the companies.

The association this year was most fortunate in having as its president a man thoroughly competent to handle its affairs and protect its interests. Mr. Adams has set a new pace as a presiding officer.

Another marked feature about the Columbus Convention was the large attendance at all the sessions and the fact that the meetings were attended by many general managers and representatives from the other branches of electric railway work bears evidence of the appreciation that is felt for the accomplishments of this branch. The year that has just passed—the first under the new plan of reorganization—has been a peculiarly vital one, and the results achieved give an earnest of still greater progress to be made.

The Exhibits

It is safe to say that on no other previous occasion in this country or abroad has there been such an elaborate display of electric railway material nor one in connection with any convention in which the exhibit features have played so important a part in contributing to the general success of the meeting. This portion of the convention was conducted under ideal conditions. Tracks leading to the entrance of the buildings permitted cars in which shipments of heavy apparatus had been made to be unloaded within a short distance of the exhibit spaces. The character of the buildings allowed displays to be made to the best advantage. An abundance of light entered openings in the roof and walls so that all portions of the buildings were adequately illuminated. The height of the roofs also permitted the erection of attractive booths.

The manner in which the displays were made showed the importance with which such exhibits are regarded by the manufacturers and supply dealers. Very few exhibits consisted of "dead" apparatus. Wherever possible the appliances were shown working under conditions approximating as nearly as possible those encountered in actual service. The attempts of exhibitors to show the construction and mechanism of complicated apparatus was especially noticeable. By means of parts with sections cut away or removed or by the display of the several parts of devices unassembled, the value of the exhibits was greatly enhanced from an educational standpoint. This plan often enabled those interested to see and understand in a very few minutes what would otherwise have required long and tedious explanations.

In scope the exhibits completely covered the electric railway field. The smallest parts entering into the construction of a car were features of some of the displays, while other exhibits consisted of completed rolling stock ready for operation. That the educational efforts of the manufacturers of electric railway apparatus were appreciated by the operating men present was clearly evident from the great interest they showed in looking over this elaborate collection. Altogether the exhibit was a great credit to the manufacturers and the association.

The Gas Engine in Railway Service

Mr. Winsor's paper on this topic is one to which we have looked forward with great interest. As our readers have been aware, the Boston Elevated Railway Company has been trying gas engine plants for the past few months, and as it has uniformly been both conservative and highly successful in its power plants, the results of this innovation have been anxiously awaited on all sides. To judge from Mr. Winsor's report, the experiment has been fully justified. Only one of the stations has been in continuous operation long enough to obtain reliable figures, and this was of but 700 kw rated capacity—a station certainly too small for the most economical results with steam. As in other properly administered large systems, it has been possible to keep the plant up to a very satisfactory load factor. It is worth noting that the overload capacity allowed for in the gas engines was 33 1-3 per cent, which should effectively dispose of the assumption too often made that gas engines are seriously limited in this respect. With them, as with all other engines, the overload capacity is merely a function of the nominal rating. Both gas and steam engines have loads beyond which they will not work satisfactorily, and in comparing the two they should each be put on a rating that will permit of such overloads as should properly be allowed for. The results detailed in Mr. Winsor's paper permit of comparison with steam practice upon just this basis. The Somerville station, from which his figures are derived, contains two 350-kw generating sets running at 140 r. p. m., together with the appropriate producer equipment. The engines are of the two-cylinder, 4-cycle type, the cylinders being 32 ins. x 36 ins.

To pass at once to results, the Somerville plant, working under service conditions for four months, has averaged 1.45

lbs. of coal per kw-hour on an engine load factor of about 74 per cent. During a 30 days' regular test, when the plant was running 16 hours per day on Pocahontas coal, this average fell to 1.31 lbs. per kw-hour. The fuel figures include all the coal used for any purpose.

Taking these facts at their face value, they correspond in fuel economy with a steam plant giving the kw-hour on about 12 lbs. of steam, a figure which speaks for itself. So far as reliability is concerned, Mr. Winsor expresses himself as absolutely convinced. The troubles met with have been merely such as might be experienced in working with any new plant, and the gas producer part of the plant has given no trouble whatever. This producer has proved simpler and easier to operate than a boiler plant, and requires no more labor. In fact, it appears easier to get maximum efficiency from the producers than from boilers. The water required for operating the station is relatively much less than for a condensing steam plant—less than one-third as much, in fact. The engines are singularly easy to start, and can be put into service in less than one minute. The chief trouble experienced with them has been improper ignition, premature explosions and back firing, difficulties which experience has in large measure eliminated, so that it will not, even if not further improved, interfere materially with regular and successful operation. The full economies of the ease are not set forth, and, of course, it is too early yet for reliable figures upon depreciation, but Mr. Winsor judges that, with coal at $3 or more, the gas station will make a material saving in the net cost of power. With the coal bill cut practically in half, there seems to be no good reason why there should not be a very considerable saving, even allowing for higher first cost and larger depreciation. A steam plant no larger than the gas plant here considered would be certain to give far less favorable figures. By and large, the results of the experiment seem to have been highly successful, and should set engineers at some hard thinking. The fuel cost of a steam station is so considerable a proportion of the total cost of power production that cutting it in two means a saving greater than can be nullified by any reasonable estimate of extra fixed and operating charges. Unquestionably the fuel cost of steam can be considerably reduced, and the gas engine can apply moral suasion that should lead to immediate improvement.

A Study in Economy

Mr. Goodenough's paper on the relative economy of engine and turbine plants is, in a degree, mis-named. As an actual comparison of engine and turbine economies it is rather of academic than of practical value, since it makes two assumptions that invalidate the practical results. The first of these is that the turbine is to have the advantage of 150 deg. superheat, while the engine works on saturated steam. Obviously a comparison of fuel costs on such a basis is rather a comparison of conditions than of prime movers. In one instance the turbine is assumed to run on saturated steam, but the engine is never given the benefit of superheating, generally more helpful to it than to a turbine in point of economy. Second, the turbo-generator is assumed to cost, apart from all questions of condensers and foundations, 20 per cent less than the engine-driven set. In close competitive bidding the difference is usually in the other direction. We grant that the turbine will probably be cheapened, but present conditions show high prices, owing to costs of development and exploitation. Two other assumptions may be considered as offsetting one another—that the labor costs are equal and that the turbine, at rated load, is materially the more economical of steam. Generally speaking, the turbine-engine controversy has thus far been inconclusive. In some respects the former has "made good" in admirable fashion—and may the best prime mover win. One must not, however, look to this paper for practical information on competitive costs, for the assumptions preclude a proper basis of comparison.

Quite apart from all this, Mr. Goodenough has given a paper very valuable to the central station manager, in showing the relation of total cost of power to fuel consumption and load in a very striking manner. Intensive operation has in a general way been understood, but we have never seen the facts more effectively put than here, and the turbine-engine comparison is a good way of emphasizing them, since these two prime movers differ materially in their customary load-characteristics. The fundamental point elucidated is that wherever on the load curve of a prime mover the point of maximum fuel economy may lie, the point of minimum power cost lies further along toward the region of higher loads. Hence a prime mover with its maximum efficiency at three-quarters load may require a load factor of unity to give its minimum cost of power; while one with maximum efficiency at full load may have to be pushed to overload to get maximum plant economy. It has been so usual to omit fixed charges in figuring the costs of power that the varying effects of such charges have been too much neglected. To secure energy at the lowest possible cost per kw-hour the controlling factor to be borne in mind is quite as often the fixed charge as the relation of fuel cost to load. The fixed charge per kilowatt falls off steadily as the load on a given station increases. It continues to decrease even on overloads until the ultimate capacity is reached. At and near this point there are likely to be increased attendance and depreciation charges, which are not taken into account in this paper; and the fundamental question is how great an output can be delivered from the given station before the total charges, aside from fuel, begin to rise. Given this point, the prime mover and its attached generator should have its maximum fuel economy as nearly as may be coincident with it, and the better this economy, the better then the whole station economy. Other things being equal, the flatter all the curves, the better. From this viewpoint the station should be planned on the basis of maximum capacity and rated back to a point determined by the requirements of maximum load. At this rating the fixed costs are as low per kilowatt as they can be and allow room for emergencies. Then the generating units should have their lowest fuel-cost points at the same rating, at which the station should be run. Modern stations, with their possibility of very high load factors, have brought entirely new conditions of economy, and Mr. Goodenough has done a capital thing in bringing some of them into notice. A high degree of generating-set efficiency at small loads has ceased to be important in comparison to the performance near the full rating.

PAPERS, REPORTS AND QUESTION BOX PRESENTED AT THE COLUMBUS CONVENTION OF THE AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION

BALLAST

BY C. H. CLARK,
Engineer Maintenance of Way, the Cleveland Electric Railway Company

In speaking of ballast for street railway work the writer will not confine himself to the material used directly under the ties.

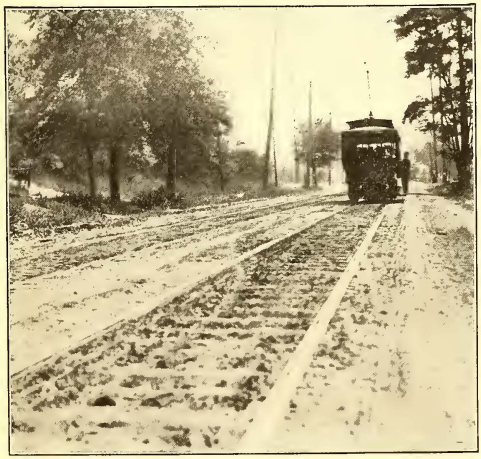


FIG. 1

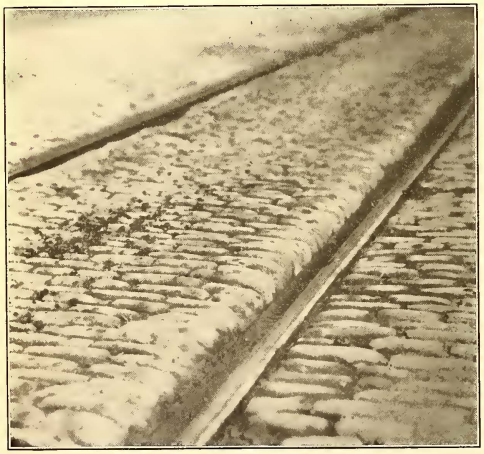


FIG. 2

We must be governed in the use of ballast by the material that the ballast is to rest upon. In Cleveland, Ohio, the greater portion of the underlying foundation is composed of sand, some of which contains a large percentage of loam. We have some streets in which clay soil predominates.

In the sandy streets, before laying our tracks, we puddle the trench. This is done by building earth dams and flooding the trench with city water. As a general rule this will cause a settlement of the original earth of 3 to 6 ins. Large crevices are sometimes formed over sewers when the sewer department has not taken all the precautions to guard against such settlement. In clay and shale, where sewers have been constructed and the tracks must be laid immediately, it is our practice to excavate the clay or shale to a greater depth than will be needed for ballast, and partly fill with sand and then cause the sand to be settled into the voids by the liberal use of water.

Having the sub-foundation thoroughly settled, we are prepared to say whether there must be a drain laid. In clay soil we have found that a drain should be laid in the space between the tracks. This has been brought forcibly to our attention by the fact that a section of track in one of our streets, which was laid in 1902 on 5 ins. of broken stone, settled in some places to a depth of 6 ins. This was caused by the water from the street getting under the tracks and allowing the broken stone to settle into the clay. We have since repaired about 1 mile of this track, and placed a drain between the tracks and conveyed the water which found its way under the ties to the nearest catch-basin.

In sandy streets the settlement of the sand by water is far superior to any other method thus far tried. Rolling with a heavy iron roller will not settle sand as it should be. I do not recommend draining sandy foundations unless they contain water.

The simplest way of tamping track is to use the material thrown out of the trench. This can only be an economical method when building suburban tracks, and the tracks are tamped on sub-grade before running the ballast trains over it. This will prevent springing of rails. This method is also used on roads which are built to sell without having operated the same. We have a large amount of track which was built when horse cars were used, or light motors. But with the heavy cars, which must sooner or later run over your tracks, a good foundation must be provided.

Tamping bars are used on gravel and sand, and tamping picks on broken stone. Tamping bars are also used on concrete under the ties and under the rail.

On a number of our streets the soil is sandy and the tracks have been down about twelve years. The rail is Lorain steel,

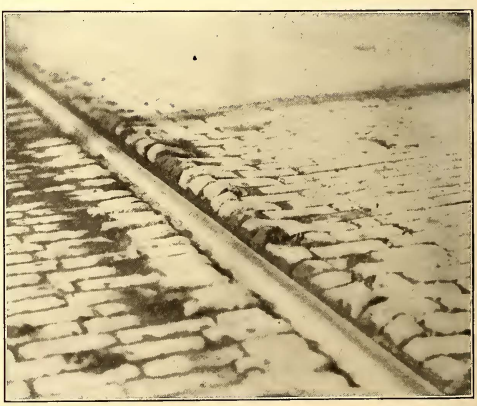


FIG. 3

90-206, laid on chestnut ties and the joints are cast-welded. The ties were tamped with the material taken out. This track has been a constant expense for the last four years, lowering high paving stones caused by the working of the rails and ties on the foundation. I cannot state just when this track commenced to work. I will refer you to the photographs, which show the high stones.

Another type of construction used by the Cleveland City Railway Company previous to 1903, was to lay 4 ins. of concrete on the bed before laying the ties. Then cover this with 1 in. of sand and tamp the ties with the sand. The space between the ties was then filled with concrete and sand laid on top of this for the paving bed. This method worked very well and gave good results, but I do not consider it as satisfactory as the concrete under and between the ties after the rail is laid. The concrete, when laid first, must not be used until thoroughly set. Of course the rigidity of the track when using concrete is greater than when using a sand construction.

A standard construction in Syracuse, N. Y., in 1895, was to use coarse gravel for the foundation. This was laid for a depth of 6 ins. and thoroughly rolled. The track was then laid and tamped with fine gravel and this thoroughly rammed between the ties to prevent settlement of the paving.

Steel ties have been used with great success by the Cleveland Electric Railway Company on some of the heaviest lines. The Lorain Steel Company ties were laid every 10 ft., alternating with a wooden tie spaced the same distance. Eight inches of concrete was laid under the steel ties, and 4 ins. under the wooden ties and a beam 10 ins. deep under and along the rails. To date we have had no trouble with this track, some of which has been down three years. I examined some track of the same construction in Detroit, Mich., in 1903, and found the ties were not stiff enough to withstand the outward pressure of the rails. I attribute this to the concrete. I found that the concrete was not of sufficient quality to withstand the strain placed upon it, thus allowing the ties to buckle.

The Seitz tie, manufactured by Seitz Bros., Tiffin, Ohio, is a very good steel tie, made on the plan of an inverted channel. The ties are very strong. They have been in use there about two years. The ballast is laid the same as with the Lorain Steel Company tie.

The Carnegie steel tie, which is an eyebeam with a 4½-in. top and 8-in. bottom flange and 5½ ins. deep, is also used by us. The ties are spaced 6 ft., and the concrete is tamped 4 ins. under the tie and 10 ins. along and under the rail. Tie rods are placed over each tie. These ties I believe to be the strongest and most durable yet placed on the market.

All objections to steel ties buckling and deteriorating seem to have been removed by the present shape of the Carnegie steel tie. Great care must be taken in cross-bonding when using steel ties, or in fact any tie. The action of the current in passing from one rail to the other through the tie rods and steel ties causes more or less eating away of the ties and rail where they are in contact. As to relaying of rails when worn out without disturbing the roadbed, I do not believe much can be said. The bolts cannot be used again and it is well when placing the concrete around the tie to see that a small space is left and filled with sand in order to loosen the fastenings without much difficulty. In all, I do not believe too much can be said regarding the design of the steel tie furnished by the Carnegie Steel Company. Regarding the cost of same installed, I will submit a table showing the actual cost of using them as compared with white oak ties:

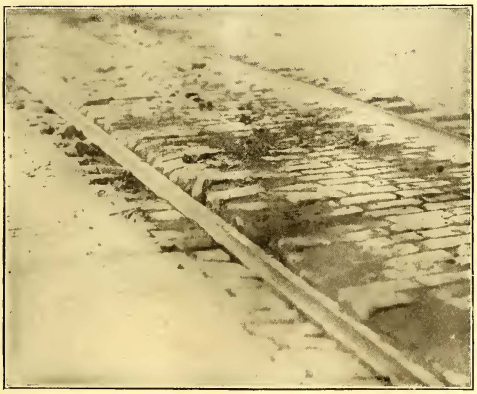


FIG. 5

TABLE—CARNEGIE STEEL TIE

Ties spaced 10 ft. apart:	
10 ties, per 100 ft., at $2.50 each	$25.00
16.4 yds. concrete, at $5 per yard	82.00
Total	$107.00
Ties spaced 6 ft. apart:	
16⅔ ties, per 100 ft., at 50 cents each	$41.66
17 yds. concrete, at $5 per yard	85.00
Total	$126.66

FIG. 4

Ties spaced 5 ft. apart:	
20 ties, per 100 ft., at $2.50 each	$50.00
17.29 yds. concrete, at $5 per yard	86.45
Total	$136.45

FIG. 6

Ties spaced 4 ft. apart:	
25 ties, per 100 ft., at $2.50 each	$62.50
17.17 yds. concrete, at $5 per yard	88.85
Total	$151.35
Ties spaced 3 ft. apart:	
33⅓ ties, per 100 ft., at $2.50 each	$83.33
18.5 yds. concrete, at $5 per yard	92.50
Total	$175.83

Comparative table of cost of ballast and ties for different types

of construction, allowing 40 cents per foot for oak ties, spaced 2 ft. apart.

No. 1—Tamping with material taken out; no extra excavation:

Tamping	$0.04
Tie	40
Total	$0.44

FIG. 8

No. 4—All concrete; 5 ins. below, and filled to the top of the tie:

.218 yd. of concrete, at $5 per yard	$1.09
Extra excavation and removing the same	7
Tie	40
Total	$1.56

No. 5—Four inches concrete; 1 in. sand under tie, and concrete between the ties:

.208 yd. concrete, at $5 per yard	$1.04
Extra excavation and removing same	7
Tie	40
Total	$1.51

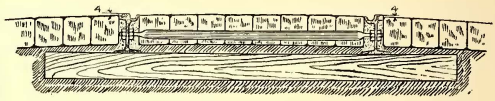


FIG. 9

FIG. 10

FIG. 11

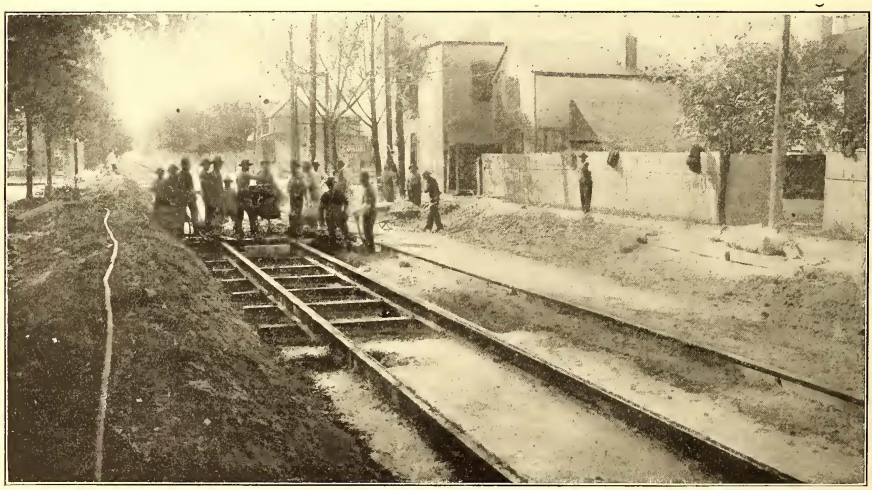


FIG. 7

No. 2—Seven inches broken stone under ties, and concrete between the ties:

.18 yd. crushed stone, at $1.50 per yard	$0.27
.1 yd. concrete, at $5 per yard	50
Tamping crushed stone	8
Extra excavation and removing the same	7
Tie	40
Total	$1.32

No. 3—Seven inches broken stone under ties, and broken stone between the ties:

.28 yd. of stone, at $1.50 per yard	$0.42
Tamping the same	8
Extra excavation and removing the same	8
Tie	40
Total	$0.98

It will readily be seen by the above table that the steel tie laid in concrete is cheaper than the white oak tie laid in concrete or broken stone. This on the assumption that white oak ties cost 80 cents apiece. This price, of course, varies in different localities, and the difference in price can readily be applied for comparison. The life of the steel tie can readily be placed at twenty years, and the white oak at about twelve years.

I have found in repairing old tracks that the concrete which has been laid for four or five years was very poor. It has been my practice not to make any but first-class 1-3-6 concrete. This may cost more than the concrete that would pass city inspection, but you will find that the best is none too good for your company in the long run. By using the best of concrete between the ties, the concrete will take the place of the tie in carrying the rail. The sketches show the different classes of construction on which

the estimates were based. The photographs have been taken with the object in view of showing what effect the different foundations have on the pavements. The foundation supports the rails as well as the pavements.

In conclusion, I would recommend that drainage pipes be placed

FIG. 12

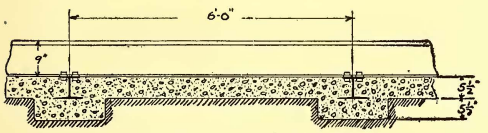


FIG. 13

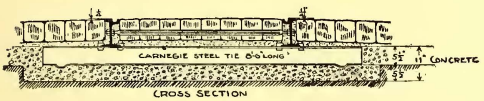


FIG. 14

in clay soils, in all wet sandy soils, and that when the traffic can be kept off the track, that a solid foundation of concrete, made in the proportion of at least 1-3-6 with best Portland cement. Bring your concrete up to within 1 inch of the bottom of your pavement. The first cost of your foundation may seem large, but the cost of the annual maintenance thereafter will be greatly reduced.

TIES, POLES AND POSTS

BY C. A. ALDERMAN,
Chief Engineer Cincinnati Northern Traction Company

On account of the former abundance and cheapness of wood, together with the comparatively light wheel loads prevalent up to the beginning and during the early part of the last decade, the tie question was one which naturally solved itself. Owing to the growing scarcity and consequent increase in the price of timber, the question is one which is daily more forcibly presenting itself to those in charge of our railways to maintain them in such condition as to economically and safely carry the heavy wheel loads imposed upon them by the advances of modern practice. At the present time the cost of ties, poles and posts in the construction and maintenance of a street or interurban railroad is of such proportions that the greatest care and knowledge of what is best and most economical to use is of the utmost importance.

Ties constitute nearly one-third the total cost of the material for the construction of the modern interurban track, exclusive of ballast and roadbed. Their selection and use is, moreover, a matter of special concern, from the fact that their life is short, and constant renewals must be made. Poles are of somewhat less, although of very great importance also in the makeup of the material account of the road. Posts for the road, built on a private right of way, form quite an important item in the cost of construction and maintenance.

Much attention is being given to the intelligent purchase and treatment of ties, poles and posts by railway men, both steam and electric, during the past few years. Our forests, from which the timber for their manufacture comes, are rapidly disappearing. Timber is becoming scarce and consequently very expensive. In bringing this subject to your attention, I will speak of ties first, as they are the most important, poles, second, and posts, which are the least important, last.

There are a great many different specifications in use by the various steam and electric railroads throughout the country. Steam roads, as a usual thing, buy their ties under a more rigid set of specifications than electric roads, for two reasons. First, they have been in the business longer, are better organized, and have had years of experience in buying and inspecting ties. Second, a large number of the prominent steam railroad systems run through tie timber country, and for this reason they can enforce more exacting specifications in the purchase of the ties. They can take the best ties for their own use, allowing the inferior ones to be shipped out to electric roads.

The specifications in use by the Cincinnati Northern Traction Company and the other interurban roads in Ohio and Indiana, controlled by the same interests, are as follows:

SPECIFICATIONS FOR STANDARD CROSS TIES, THE CINCINNATI NORTHERN TRACTION COMPANY

Quality of Timber

All ties to be cut within fifteen months from the time of delivery from sound, straight, live and thrifty timber, free from loose or rotten knots, dry rot, wind shakes, or any other imperfections affecting the strength or durability of the timber. All ties to be strictly first class.

Kind of Timber

White oak, burr oak, chestnut oak, black locust, black walnut and wild cherry.

Dimensions

Six inches (6″) thick, eight inches (8″) width of face, eight feet (8′) long.

Seven inches (7″) thick, eight inches (8″) width of face, eight and one-half (8½′) feet long.

In hewn ties a variation in above dimensions of one-fourth inch (¼″) in thickness, one-half (½″) in width of face, or one inch (1″) in length of ties will be allowed on a small percentage of the ties that are otherwise fully up to standard. Pole ties having a width of face of seven inches (7″) and otherwise up to standard will be accepted.

Full dimensions will be required in all sawed ties.

Workmanship

Hewn ties must be stripped of bark, hewn smooth and clear of all splinters, straight, of uniform thickness, the two faces out of wind and parallel throughout, and ends sawed off square. One inch of sap wood on two corners or 2 ins. of sap wood on one corner will be allowed.

Prices

Proposal will state prices for ties, based upon the above specifications, as follows, f. o. b. point of delivery:

For cross-ties, 6 ins. x 8 ins. x 8 ft.....each
For cross-ties, 7 ins. x 8 ins. x 8 ft.....each
For pole-ties, 6 ins. x 8 ins. x 8 ft.....each
For pole-ties, 7 ins. x 8 ins. x 8½ ft.....each

Under these specifications, it was found very hard to get anyone to sell ties to us, so the specifications were amended to allow a variation as follows:

(To constitute not more than 10 per cent of order.)

First-Class Ties	Pole Ties	Split Ties	Sawed Ties
Depth not less than.....	5¾ ins.	5¾ ins.	6 ins.
Face not less than.....	6 ins.	7 ins.	6 ins.
Face swell not less than....	8 ins.	.....	8 ins.
Length .....7 ft. 10 ins. to 8 ft. 2 ins.		7 ft. 10 ins. to 8 ft. 2 ins.	8 ft.

(To constitute not more than 5 per cent of order.)

Second-Class Ties	Pole Ties	Split Ties	Sawed Ties
Depth not less than.....	5½ ins.	5½ ins.	5½ ins.
Face not less than.....	4½ ins.	6 ins.	6 ins.
Length not less than..... ..	7 ft. 10 ins.	7 ft. 10 ins.	8 ft.

Ties purchased under these specifications are costing from 65 to 70 cents, delivered at convenient shipping points in Ohio and Indiana. Tie inspectors are stationed at the shipping points, and all ties are accepted and classified before loaded. The greater part of these ties are coming from Kentucky, and some from Southern Ohio.

The chemical treatment of ties with preservatives is becoming an important industry in the United States, as it has been in Europe for a great many years. Tie preservation is to-day being scientifically investigated and practiced by nearly all of the leading steam railroad systems of this country. The various methods for the treatment of ties are as follows: Creosote, chloride of zinc, zinc and tannin, and zinc and creosote. The straight treatment of ties with creosote of the dead oil of tar is acknowledged by all authorities on the subject to be the best, but it is also the most expensive.

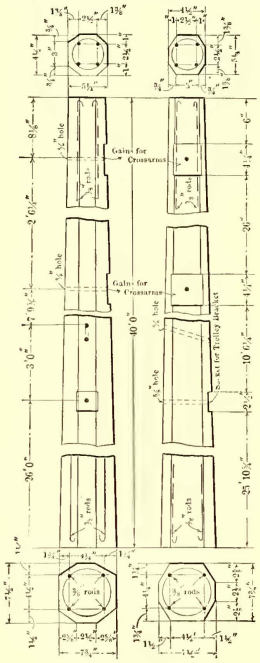
I am indebted to C. S. Walker, president of the Southern Creosoting Company, for the following notes on the preservation of timber: "The theory of wood preservation by the application of creosote is first to thoroughly sterilize the tie with steam in hermetically closed cylinders, thus destroying all germs of wood-rotting fungi, and at the same time producing heat that will vaporize the fluids contained in the timber. The second operation is the subjection of the timber to a vacuum of about 25 ins., maintaining a temperature of about 100 degs. C. in the cylinders at the same time. By this second process all vapors are discharged through vacuum pumps, and in properly constructed plants any condensed liquid is collected in the drainage tank located beneath the cylinder. The material, now thoroughly dessicated and heated, is ready for the application of oil. Creosote heated to

150 degs. C. is admitted from measuring tanks without breaking the vacuum and kept at that temperature by steam coils and cylinders. The wood, if time-seasoned, or well steam-seasoned, will absorb from 10 per cent to 25 per cent of the required amount of oil before any pressure is applied. When the cylinders are full the required number of pounds of oil are injected under pressure, the usual treatment being from 8 lbs. to 16 lbs. per cubic foot for inland, and 16 lbs. to 22 lbs. for seacoast work, allowance being made for the average absorption of oil by the timber. After the requisite amount of oil has been injected into the tie the remaining oil is drained into underground tanks, and the amount of oil consumed is measured and checked against the theoretical amount demanded. The practical results of laboratory experiments can only be approximated. Exact measurement of the creosote cannot be expected. It is necessary that cylinder pumps, steam coils, and all other machinery of the wood treating plant be in perfect condition, so that the timber is thoroughly sterilized and a proper penetration of the creosote is secured. The timber being sterilized, all outer cells are covered or filled with an insoluble body, preventing access of air or water to the interior."

The cost of treating ties with the straight creosote process varies slightly, but will average about 30 cents per tie, whereas the zinc process will not be over 6 cents per tie.

With regard to trolley poles, some progress has been made in preservation, but only to a very limited extent. Mr. Crump, of the firm of Ford, Bacon & Davis Company, makes a statement regarding creosoted trolley poles which is to the effect that they are a much better conductor than the ordinary wood pole without treatment. He says, "In our regular work, we double insulate all our spans in the same manner that we would for steel-pole construction." He further says that the Lighting Company, of Memphis, Tenn., does not use creosoted poles, as there is too much leakage of current at their voltage, which is about 3000.

When the electric railway was in its infancy the size of a trolley pole was about 25 ft. in length, with 6-in. top. Later on poles were used 30 ft. in length, then 35 ft., and the top dimension was changed to 7 ins. The next step was to change the top dimension to 8 ins., and the latest and best practice is to use a pole 40 ft. in length with an 8-in. top. This is almost universal practice where the alternating-current wires are to be taken care of on the same line of poles as the trolley.

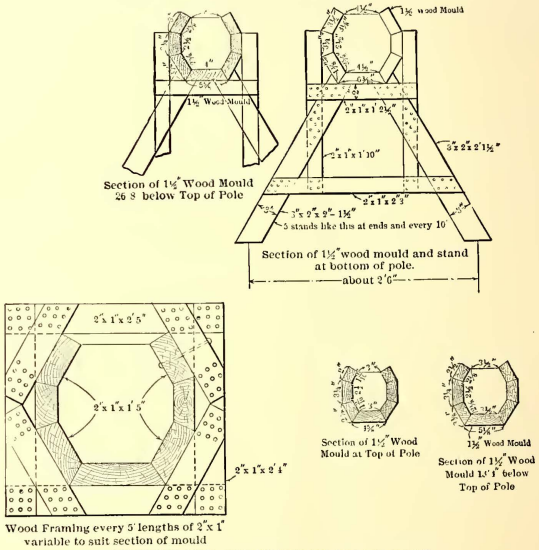


CONCRETE POLE

Poles have pretty generally been of cedar, although quite a number of juniper from the Southern States have been used. Chestnut poles have also been used, but their great weight caused them to be quite objectionable to erect. Idaho cedar, so called, is coming into the market very lively just now as a trolley pole timber. The poles are very straight and fine looking, but are not stocky or massive like Michigan cedar. Their size at the butt is but very little larger than at the top. As to their lasting quality I do not think they have been in use long enough yet for us to give a reliable opinion.

The writer's experience with fence posts has been that a good grade of red cedar posts is about the best that can ordinarily be obtained. Black locust is said to be, and undoubtedly is, the very best timber that can be found for posts, but it seems to be a hard matter to get them, and, if gotten at all, it will be in such small quantities that one does not feel repaid for the effort made in obtaining them. A good cedar post 7 ft. long with 4½-in. to 5-in. top, on the other hand, is always quite readily obtained, and will perform very creditable service.

Concrete for ties, poles and posts, has been proposed and used to a limited extent by a few. My own idea is that concrete is not very well adapted for use as a railroad tie, but I see no reason why it should not be a success in trolley poles or fence posts. I submit herewith a drawing of a proposed reinforced concrete trolley pole, which I expect to see used to a very large extent within the next few years. The greatest objection to this concrete pole is its weight, but it will have to be set with a derrick, and can be done, I believe, for a not very large cost. Concrete posts have been used to quite an extent and are no longer an experiment.



MOULDS FOR CONCRETE TROLLEY POLE

Old rails have been used for ties in London by the London United Tramway Company. The ties were spaced 9 ft. apart, and consisted of 6-ft. lengths of old tramway girder rails with a

Steel cross-ties of various shapes have been designed and used for railway track; the two forms used being a modified I-beam and a channel. About a year ago the Carnegie Steel Company got out a circular or catalogue illustrating a steel tie, which is an I-beam (top of the beam) 5½ ins. high, the top flange being 4½ ins. wide, the bottom flange 8 ins. wide. Length, 8 ft. 6 ins. Weight, 19.7 lbs. per foot, or 167.4 lbs. per tie; exclusive of the fastenings, which weigh about 6 lbs. The rail is secured to the tie with four ¾-in. bolts, by means of rolled steel clips fitting on the flange of the rail, having a bevel the same as that of the flange and punched so that the shoulder of the lip gives accurate rail alignment. Proper insulation where automatic block signals are to be used is provided for by the use of wooden shims between the rail and the tie, fiber bushings being used around the bolts and fiber washers under the nuts.

depth of 6 ins., and a flange of the same dimension. These rails were embedded in the concrete foundation, with the flange uppermost, and were firmly fastened to each rail by means of two ⅞-in. bolts with beveled washers.

At the May meeting of the American Railway Engineering and Maintenance of Way Association, W. C. Cushing, chief engineer of maintenance of way Pennsylvania lines west of Pittsburg, S. W. system, exhibited a series of very interesting tables upon the comparative value of cross-ties of different materials. From these tables he made the following deductions:

DEDUCTIONS FROM TABLE 1

(1) With white oak ties costing 70 cents delivered on the railroad, it is economical at the present time to buy inferior woods at a price not to exceed 50 cents, have them treated with zinc-chloride or zinc-tannin, lay them in the tracks without the use of tie-plates (except where it is necessary to use them on oak ties) and use a standard railroad spike. A life of ten or eleven years has been found to be a maximum for such ties without the use of tie-plates and better fastenings, and if the life of ten years is not attained there will be that much loss to the company.

(2) When a white oak tie reaches a cost of 86 cents or 87 cents delivered on the railroad, it will be economical to use the zinc-creosote process, or straight creosote costing 30 cents, if the tie costs 46 cents delivered on the railroad and will last sixteen years; or, it will be economical to use straight creosoting costing 85 cents for treatment if the tie can be made to last thirty years, which is French practice before the oak tie reaches a cost of 80 cents delivered on the railroad. In both of these cases it is assumed that tie plates, wood screws and helical linings are used because ties cannot be made to last more than ten or twelve years without the use of proper fastenings, since, otherwise, the tie will be destroyed by mechanical wear. It is necessary, therefore, to use improved fastenings when we expect to obtain a life of ties greater than ten or eleven years. It will also be economical to use a steel tie costing $1.75 delivered if it will last twenty years.

(3) When the white oak tie reaches a cost of 90 cents delivered on the railroad, it will be economical to use either ties of inferior woods treated with zinc-tannin if a life of fourteen years can be obtained, the improved fastenings being used; or a concrete tie costing $1.50 if it will last twenty years.

(4) When the price of white oak ties reaches $1 it will be economical to use a steel tie costing $2.50, if it will last thirty years, a concrete tie costing $2.25, if it will last thirty years, or an inferior wood tie treated with zinc-chloride, if a life of twelve years can be secured.

DEDUCTIONS FROM TABLE 2

(5) With ties of inferior wood costing 46 cents delivered on the railroad, we must obtain a life of from eighteen to twenty years, whether treated with zinc-chloride, zinc-tannin or zinc-creosote, to make them as economical as white oak ties costing 70 cents. It is assumed, of course, that they must have the most approved fastenings in order to attain an age as great as that.

(6) With inferior wood costing 46 cents delivered on the railroad, and if the creosoting cost 30 cents, it will be necessary for us to obtain a life of twenty-one years in order to make them as economical as white oak ties costing 70 cents delivered.

(7) With inferior wood ties costing 46 cents delivered, and with the creosote treatment costing 85 cents, as in French practice, it will be necessary for us to obtain a life of thirty-six years from the ties in order to make them as economical as white oak ties costing 70 cents delivered.

(8) With steel ties costing $1.75 each delivered, it will be necessary for us to obtain a life of twenty-eight and one-half years in order to have them as economical as white oak ties costing 70 cents delivered. This price is a little less than the cost of the Buehrer steel ties in the tracks at Emsworth.

(9) With concrete ties costing $1.50 each delivered, it will be necessary for them to last twenty-eight years before they will be as economical as the white oak ties costing 70 cents delivered.

(10) With steel ties costing $2.50 delivered and concrete ties costing $2.25 delivered, which are approximately the prices of the Seitz steel tie and the Buehrer concrete tie, in the tracks at Emsworth, it is necessary for them to last over fifty years each in order to make them as economical as the white ties costing 70 cents delivered.

DEDUCTIONS FROM TABLE 3

(11) In order to make treated inferior woods as economical as white oak costing 70 cents delivered, when the treated ties are equipped with proper fastenings in order to make them last as long as has been found practicable by experience, we can only afford to pay for the ties delivered on the railroad 10 cents each when treated with zinc-chloride; 20 cents each when treated with zinc-tannin, or creosoted at 30 cents; 23 cents each when treated with zinc-creosote, and 29 cents each when creosoted in accordance with French practice.

(12) In order to make them as economical as white oak ties costing 70 cents delivered, we can only afford to pay $1.48 each for steel ties which last twenty years, and $1.79 each when lasting thirty years.

(13) In order to make them as economical as white oak ties costing 70 cents delivered, we can only afford to pay at first cost of concrete ties delivered, $1.15 each, if they last twenty years, and $1.57 each if they last thirty years.

(14) We know nothing about the life of concrete ties, and it is at least very desirable to experiment with them for yard and side tracks, even though we do not use them in the main tracks, because they might lie undisturbed in yard tracks for many more years than they would in main tracks.

(15) When white oak ties are costing 70 cents delivered (about present prices) we can afford to buy inferior oak and other hard woods at 45 cents to 50 cents (present prices) and have them treated with the zinc-tannin or zinc-chloride processes, and only use the common spike fastenings.

My only experience in the use of steel ties was in the construction of the Central Market Railway, Columbus, where we used a steel channel furnished by the Lorain Steel Company in laying the tracks across the Fourth Street Viaduct. These ties rested on a concrete base, and no trouble has been experienced to my knowledge in the maintenance of this piece of work.

Undoubtedly steel cross-ties will be used to quite an extent as soon as timber advances in price, say 10 to 20 per cent.

The rapid consumption of timber in this country is causing an increase in cost and a consequent reduction of the supply of timber suitable for ties, bridge timbers, etc.

The following figures will explain to a certain extent the scarcity of tie timber in the United States, and the reason why ties are becoming so expensive.

There are now in the United States about 200,000 miles of railroad, which with second track, sidings, and yard tracks all added will aggregate over 250,000 miles. This 250,000 miles of railroad requires 660,000,000 ties. The average life of a tie, untreated, is not over eight years. This means that 82,000,000 ties are required annually for renewals alone, or the timber from half a million acres of forests.

UNDERGROUND CABLES

BY H. G. STOTT,

Supt. Motive Power, Interborough Rapid Transit Co., New York City

The use of underground cables for the transmission of power by electricity has become so universal that no apology is necessary for bringing before the members of this association a few points which seem to the author to have failed to receive the attention they deserve.

Underground cables, as used by the members of this association, may be grouped into three classes, viz.:

(1) High-tension multiple or single conductor cables of relatively small current carrying capacity, but capable of operating under working pressures from 2500 to 25,000 volts mean effective pressure.

(2) Low-tension single conductor cables of large current-carrying capacity, but only operating under pressures of 650 volts or less.

(3) Negative return cables of large current-carrying capacity, but only operating under a pressure corresponding to the drop in the return feeders.

The first class, comprising what is popularly known as high-tension cables, has developed by a process of evolution from the time when nothing but rubber was used for insulation, to the present time where rubber, varnished cambric, saturated tapes and paper insulation have been brought to such a state of perfection as to leave little to be desired.

Higher voltages than 25,000 have not been attempted as yet in underground cables, but there seems to be no reason why a voltage of 44,000 should not be used with exactly the same degree of safety as 25,000, provided a star connection is used in the transformers and the neutral point is grounded, for then the maximum strain is limited to 25,000 volts to ground. It would thus seem that our cable manufacturers have almost kept up with the

development in overhead construction, as at this time 60,000 volts is the maximum pressure in use in a few cases only, and the great majority of important transmission schemes are under 50,000 volts.

For economic reasons, principally, rubber insulation is only used where local conditions seem to demand an insulation which is impervious to moisture, so that in case the lead sheath should be punctured, the cable will not necessarily fail.

As an instance, where cables have to be installed in ducts, which are under water part of the time, or for submarine cables, the extra investment for rubber insulation would seem to be justified, as in the event of a leak in a submarine cable lead sheath it usually becomes a total loss if insulated with paper or other non-moisture proof material, whereas good rubber will last indefinitely under water.

For potentials above 22,000 volts it seems likely that some form of varnished cambric or impregnated cloth will take the place of paper, owing to its higher puncture resistance for a given thickness, but experience with working pressures above 22,000 is so limited that we must wait for some time before any definite conclusions can be reached.

As the result of some fifteen years of experience with underground cables, the following table, giving thickness of insulation and lead sheath for various sizes of conductors and working pressures, is submitted as representing conservative practice:

TABLE NO. 1.—PAPER INSULATION. STANDARD WORKING PRESSURE OF 3000 VOLTS

Size of Conductors	Thickness of Insulation	Thickness of Lead, Single Cond.	Thickness of Lead, Three Cond.
No. 6 to No. 2 B. & S.....	5-32 in.	5-64 in.	3-32 in.
No. 1 to No. 00.....	5-32 in.	3-32 in.	7-64 in.
No. 000 to 300,000 cm.....	6-32 in.	7-64 in.	9-64 in.
400,000 to 750,000 cm.....	6-32 in.	7-64 in.	.....
800,000 to 1,000,000 cm.....	7-32 in.	4-32 in.	.....
1,250,000 to 2,000,000 cm.....	8-32 in.	9-64 in.	.....

For each 1000 volts increase of pressure above 3000 add 1-32 in. insulation to the wall until 11,000 volts is reached, and after that add 1-64 in. for each 1000 volts. For example, the insulation required on a No. O B. & S. 25,000-volt cable would be 20-32 in. or 5/8 in. If 35 per cent para rubber compound or varnished cambric is used for insulation, the above empirical rule may be changed to read: for each 1000 volts increase above 3000, add 1-64 in. insulation to the thickness of wall until 25,000 volts is reached. For the insulation of low potential cables in class II., 4-32 in. paper should be used on all sizes up to 1,000,000 c. m., and from 1,250,000 to 2,000,000 c. m., 5-32 in. should be used.

From a purely electrical point of view one-half of this insulation would be ample to withstand 650 volts working pressure, but the mechanical effects of reeling and unreeling the cable and pulling it into ducts and bending around the manholes, are to practically destroy the insulating qualities of the layer of paper next the lead, so that we really start in with a cable having approximately 1-32 in. of its insulation destroyed before it is put into commission; this mechanical destruction of insulation is especially marked in cold weather, as the oils used with the paper tend to congeal when subjected to a temperature below 32 degs. F. The cable manufacturers have met this difficulty by using more fluid oil with the result that the insulation resistance of the cable may not be more than fifty megohms at 60 degs. F., but by the use of this very soft insulation they have produced a cable giving a very low insulation, but a high puncture test, and at the same time have met, to a great extent, the difficulty of handling paper cable in cold weather. It is always advisable, however, if a cable is to be used in a temperature below 32 degs. F. to keep it in a warm place, such as a boiler room, for at least 12 hours before drawing it in. The cable may then be used in the coldest weather, as it gives up its heat very slowly.

Class III. cables have up to within the last three years received very little attention, as, in almost every case, bare copper cables were installed. But a closer study of the electrolysis problem indicates that in many instances the use of insulated, negative cables would eliminate a great deal of the trouble and damage to cable sheaths. etc.

When electricity leaves a conductor in wet or moist ground the water in its path is decomposed into its constituent gases, having the chemical symbols H_2 O, and oxygen attracts almost all metals, forming an oxide of iron or oxide of lead or copper, as the case may be, slowly but surely destroying the metal. A pressure of two volts is sufficient to decompose the water, so that the ordinary negative drop of from five to twenty-five volts possesses ample possibilities in the way of electrolysis, if not properly taken care of.

In the ordinary location of d. c. power plants in our smaller cities, only one generating station is used, and sufficient positive copper is installed to give the necessary potential on the trolley, the negative or return circuits being taken care of by the track rails up to the nearest point to the power plant or sub-station, and from this point bare negative feeders are used to conduct the current back to the grounded negative bus in the station. The maximum amount of copper installed in this negative rarely equals that used for the positive, so that in all probability there will be at least five volts drop from the nearest track rail to the negative bus, and if longer bare negative feeders were used running to the various points of heavy traffic, the drop on them will be at least 4 per cent, as the financial burden caused by interest on capital invested becomes too great if a smaller drop than this is used. We thus have bare negative feeders with a potential of from 5 to 25 volts on them, running parallel to our positive and high-tension feeders, as well as our neighbors' cables, gas mains, water mains, etc., and a few bar rail-bonds may increase this drop several per cent.

The negative feeder may, therefore, be looked upon as an infinite number of small battery cells coupled in series with their negative pole, coupled to the negative bus in the power house or sub-station, and their positive coupled to the track rail, with some good and some bad connections, all along the line to the various lead sheaths of the cables running near them, as well as to gas mains, etc. If the connections between one of these imaginary cells and a lead sheath be sufficiently good, then this battery's potential of perhaps 10 volts will be on the cable sheath and will cause a current to flow from it at some other point along the line where the negative return is at a lower potential. At the point where the current leaves the lead sheath, electrolysis will occur, and in time the feeder will break down from the moisture admitted through the perforated lead sheath.

The above conditions obtain to a greater or less extent in all systems having bare negative returns and grounded negative bus-bars, no matter how many sub-stations may be in use.

An obvious remedy would seem at first sight to be the bonding of the lead sheaths of all feeders to the bare negative cables at frequent intervals, but this introduces another trouble which may be as serious as electrolysis. A short-circuit in a positive feeder, to ground, will cause an enormous current to flow through the lead sheaths, and in all probability burn off the bonds and destroy the lead sheaths in a number of cables. Instances of this have occurred to the author's knowledge, in which the lead sheaths have been completely burned off for 400 ft. on cables that were entirely innocent of the origin of the trouble.

Another source of trouble, due to the use of the grounded negative bus and bare feeders, is in the other feeder's lead sheaths carrying the negative current back to the power house or sub-station by an entirely different route from that taken by the bare negative feeders, with the result that this return current leaves these lead sheaths, either in the power house through a ground put on them, or through some accidental ground, such as a cable hanger in a manhole. Every time a short-circuit comes on the system a rush of current will flow through these lead sheaths, and, perhaps, puncture small holes in the lead.

The most satisfactory solution of these problems of avoiding electrolysis and saving the lead sheaths from destruction seems to be in the use of an insulated negative bus in the power house and sub-station, and insulated negative feeders right up to the track rails. For this purpose, the negative feeders should preferably be insulated with some material which does not require the use of a lead sheath. Several types of insulation are now on the market, which promise to be very satisfactory for this purpose, as the potential carried by the negative feeders is quite low.

The ideal solution of the problem would be found in the use of the feeders without lead sheaths, and some very satisfactory tests are now being made on experimental lengths of 650-volt cable of this type, but it does not seem probable that any cable can be constructed at present which will safely stand being drawn into wet ducts and manholes and used continuously on pressures above 2000 volts without the protection of a lead sheath to keep out the moisture.

By using insulative negative feeders and avoiding all grounds in the power house, or sub-station, it is evident that there will be little or no tendency for the return current to leave the track rails, if properly bonded, and absolutely no tendency for stray currents to come back to the power house or sub-station by way of lead sheaths, gas mains, etc., thereby relieving us of probably 75 per cent. of our present electrolysis troubles.

Coming back to Class II. cables, the safest plan seems to be to insulate the lead sheaths of all feeders by supporting them on

racks having some form of insulation between the lead sheath and the hanger.

All cables should also be wrapped with two layers of ⅛-in. asbestos in every manhole where more than one cable is on each side, in order to afford protection from an arc caused by any one of them burning out. In perfectly dry places this asbestos wrapping can be secured very neatly by applying silicate of soda to it, the soda in itself being a good protection against fire; in the average damp manhole this soda will soon loosen and the asbestos wrapping will fall off, so that, in this case, a galvanized steel tape about ⅝ in. x 1-32 in. should be used to hold the asbestos in place.

In order to get early warning of the breaking down of any positive feeder, and so give time to have it cut out before doing any further damage to itself or neighbors, as small insulated wire (say, No. 14, B. & S.) should be connected to the lead sheath and brought up to a panel where the switchboard operator can see it. On this panel may be mounted one or two lamps for each positive feeder, and these lamps connected to ground through a resistance large enough to limit the current to the amount necessary to light the lamps when the pilot wire attached to the lead sheath to any feeder becomes alive through the grounding of that feeder on its insulated lead sheath. Ammeters or relays operating a gong may also be used with advantage for this purpose at a very small cost per feeder.

In reference to Class I., or high-tension three-phase cables, their lead sheath should be insulated and wrapped with asbestos in the same manner as described for Class II., with the additional precaution that their lead sheaths should all be bonded together and grounded in the generating plant. The neutral, or star point, of the generators or transformers should be grounded through a resistance of such dimensions as to limit the current, flowing through it when a ground occurs on a high-tension feeder, to the amount necessary to trip the overload relay. For example, on a large installation using 11,000 volts for distribution to its sub-stations, the neutral connection is one having resistance of six ohms, and a carrying capacity of 1000 amps. for 1 minute. As the Y potential to ground is 6300 volts, this limits the current to a maximum of 1000 amps., when the feeder grounds.

This system was adopted after some rather disastrous experiences with short-circuits on high-tension feeders, and has been in successful operation for over a year.

When a high-tension cable breaks down, it almost invariably goes to ground from one phase only, and then after the charging current of the whole system has been flowing to ground through this fault for perhaps 10 or 20 minutes, the insulation of the other phases is burned off, so that a short-circuit on two or three phases occurs, with the result that either the whole system is shut down, due to the sudden fall of potential, to perhaps one-fourth of its normal value, or at least one or two-sub-stations are shut down from the same cause. With the neutral grounded through a suitable resistance, the oil switches, on the grounded feeder only, trip out quietly without any disturbance whatever to the rest of the system.

If the three-phase high-tension cables are not grounded in the generating plant, the burning out of a cable will puncture the lead sheath at a number of points, possibly a thousand feet away, as it is obvious that the current must leave the lead sheath somewhere, and the easiest path is usually found at the cable hangers in the manholes. This will be true no matter whether the neutral is grounded or not.

As a further precaution, it is advisable to bond the lead sheaths of the a. c. feeders quite frequently in the manholes by wiping on a lead strap, say, ⅛ in. x 2 ins. to the lead sheaths. Bonding by wrapping the lead sheaths with a few turns of copper wire is worse than useless, as the copper wire, if put on tight enough to make a good connection, may cut through the lead, and if not tight enough to do this it will probably make such a poor contact as to arc when current passes.

In conclusion, the author wishes to state that, in his opinion, at least 75 per cent of cable trouble is caused by defects in the lead sheath and not by defects in the insulation.

Examine the ordinary vitrified duct and you will find that the inside, in all probability, contains several small hard sharp points projecting from 1-16 in. to ⅛ in. What happens to the lead sheath of a cable when it passes over these projections? A groove is cut in it in exactly the same way as by a tool in a planer. The result is that a little extra pressure, caused by a kink in the cable, will cut through the lead and admit the moisture, which, sooner or later, will destroy the insulation.

Outside of trouble in joints caused by carelessness on the part of the jointer, practically all cable trouble can be eliminated by the more careful choice and installation of conduits, by a very careful inspection at the time they are laid, and by the use of cutters and cleaners after they are laid.

Lastly, do not try to get a low price on a cable by reducing the thickness of the lead sheath, as the integrity of the lead sheath is fully as important as the quality of the insulation, and the life of the latter is wholly determined by the degree of perfection obtained in excluding moisture from it.

GAS ENGINES

BY PAUL WINDSOR,
Chief Engineer Motive Power and Rolling Stock, Boston Elevated Ry. Co.

This paper will deal with the experience that the Boston Elevated Railway Company has had with its two gas engine plants. These plants have now been in operation, one about four months, and the other (partly) for a few weeks. A little over a year ago the subject came up of supplying power to two sections of the railway that were rather hard to reach from the present power stations, and as we had for some time been looking into the question of gas engines, it was decided that this was a good opportunity to make a trial of them. Both plants are small, one of 700 kw, and the other of 975 kw. The engine load factor in both stations can be made extremely good, as they feed into the trolley lines in multiple with the steam stations of the road.

As you are not interested in the buildings I will only say that they are of brick and concrete throughout, with reinforced concrete floors and flat roofs, and that there is a great deal of light and ventilation.

The equipments of these two plants are radically different. The Somerville plant has down-draft suction producers and 4-cycle single-acting engines, and the Medford plant has up-draft pressure producers and 2-cycle, double-acting engines. Unfortunately for this paper, we have run the Medford station so little—through no fault of the equipment contractors—that no figures are available, and I must, therefore, confine most of my remarks to the Somerville station.

The Medford station has R. D. Wood gas producers, with blowers, tar extractors, scrubbers, etc.; Koerting 2-cycle, double-acting gas engines; Crocker-Wheeler generators. The gas plant is similar to, although larger than, the United States Government Testing Plant at St. Louis, which has been in continuous operation now for two years or more, making gas successfully from all kinds of coal.

The engine plant is similar to, although smaller than, the Lackawanna Steel Company's plant at Buffalo, where they have a large number of these engines running successfully on blast-furnace gas. As before stated, this plant has been run very little. This has not been the fault of the plant, but has been owing to our wishing to work out thoroughly the exhaust question before putting the plant into regular operation. The station is in a residential district, and the noise of the exhaust of the one engine started was such as to seriously annoy the neighbors. We have, therefore, been experimenting for nearly two months, during which time only one engine has been run, and that very little, so that no economy tests have been possible.

The Somerville station has a Loomis-Pettibone gas plant, with the necessary exhauster, scrubbers, holders, etc.; American-Crossley engines; Crocker-Wheeler generators. The Somerville station has been in commercial operation since May 4, 1906, and up to Aug. 31 it has used 1.45 lbs. coal per kw-hour.

From May 4 to May 29, inclusive, but one engine was in use. Since then two engines have been running. The station is run week days from 7 a. m. to 11 p. m. and on Sundays in the afternoon only. The engine load factor has been about 74 per cent.

On June 10 a thirty days' test run was begun. During these thirty days the station was run 16 hours per day, from 7 a. m. to 11 p. m., with an engine load factor of a little over 70 per cent. The average Pocahontas coal per kw-hour delivered from the station was 1.31 lbs. This included all the fuel used, whether for running the engines, building fires after cleaning, or in the auxiliary boiler.

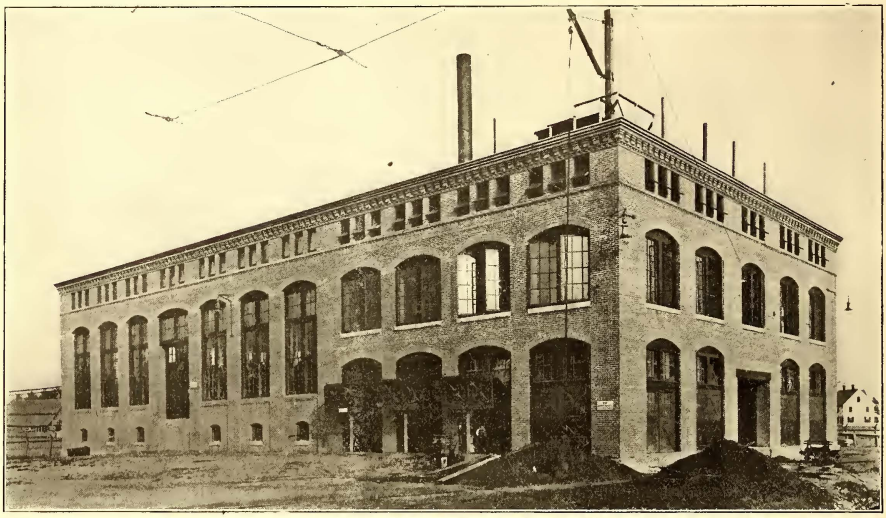
From May 4 to Sept. 3, inclusive—the four months in which the station has been in regular commercial operation—the fuel per kw-hour output has been 1.45 lbs. These figures are as good as the most enthusiastic have ever hoped for. The plant has proven its reliability, and the shut-downs have been very few. There have been no shut-downs of any kind in the gas house.

This portion of the plant has run regularly and without any trouble and has made a uniform grade of good gas.

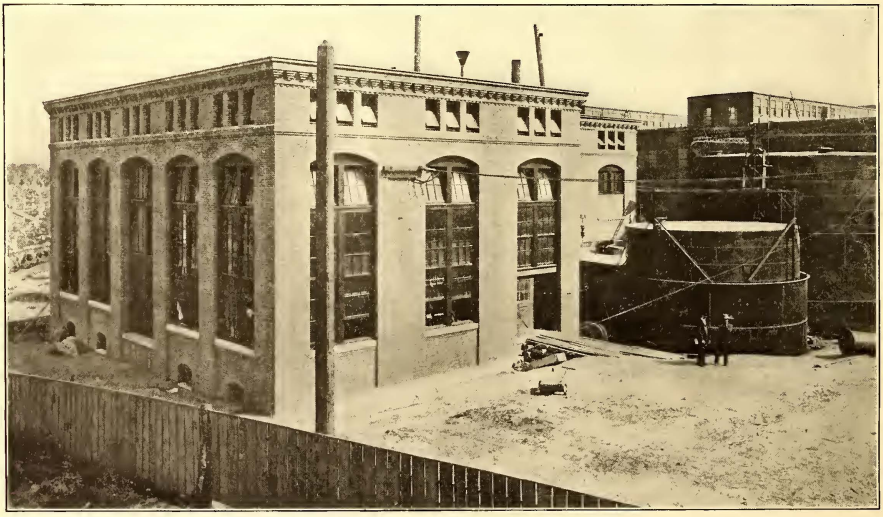
In the engine room there have been interruptions, but these have almost all been of the kind to which any new power plant is subject. The longest delays, in fact the only real shut-downs, were due to improper water connection with the piston. This matter, however, has been remedied. We have had one case of hot crank-pin, probably due to too quick starting. These engines can be set running so quickly—well inside of 60 seconds, and often close to 30 seconds—that the temptation has been to see how quickly it could be done, resulting, as before stated, in one case of hot crank-pin, the oil not having been given time to reach it after 6 hours' shut-down.

As a result of my experience with these plants, I am absolutely convinced of the economy and reliability of a gas-engine power station. The fuel consumption will be about one-half as compared with a steam plant, running from less than 1.5 lbs. to 1.75 lbs., according to the load factor and almost regardless of the size of the plant, as against 3 to 4 lbs. in similar steam plants.

The cost of the gas plant, including producers, is undoubtedly considerably higher than the cost of a similar sized steam plant, and whether the fuel saved will justify the increased capital depends on the price of coal, but it seems that with coal at $3 and upwards, there will be a material net saving by the use of gas.



MEDFORD GAS ENGINE POWER STATION OF THE BOSTON ELEVATED RAILWAY COMPANY



SOMERVILLE GAS ENGINE POWER STATION OF THE BOSTON ELEVATED RAILWAY COMPANY

Another advantage of a gas plant is the high efficiency of a small plant, the efficiency being practically the same for engines as small as a couple of hundred horse-power as for those of larger size, which of course is not true of a steam plant.

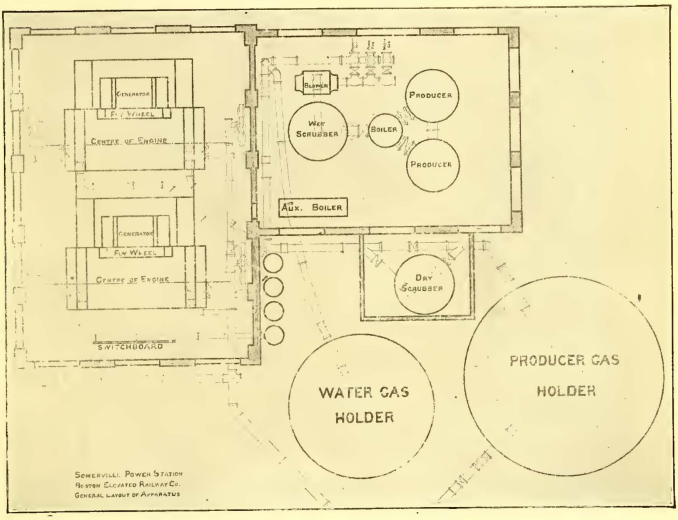
The question is of course asked: "What are the disadvantages of a gas power station as compared with a steam plant?" I am glad to say that they are few. The gas-producing portion of such a station is simpler, easier to operate, and holds its efficiency

better than a steam plant. The losses from banking fires are extremely small, and the plant can be gotten into service much quicker than can a steam plant. It is our practice to shut down at 11 at night and start at 7 in the morning. Fifteen or twenty minutes are required to get the gas plant into full operation, while of course with a boiler plant it takes from one to one and a half hours to get the fires into first-class shape. The ashes have to be periodically removed from the producer. In our plant this has to be done while the producers are out of commission and takes about 3 hours twice a week, although the plant can be run a couple of days longer without cleaning, if necessary. With some forms of producers the cleaning can be done while the plant is in operation, but I have had no experience on this point as yet, as our second plant, which has this form of producer, has not been in continuous operation. The wet and dry scrubbers have to be cleaned every two weeks, but this work is certainly no more difficult than the work required around a boiler, cleaning soot from the tubes and from the soot chambers.

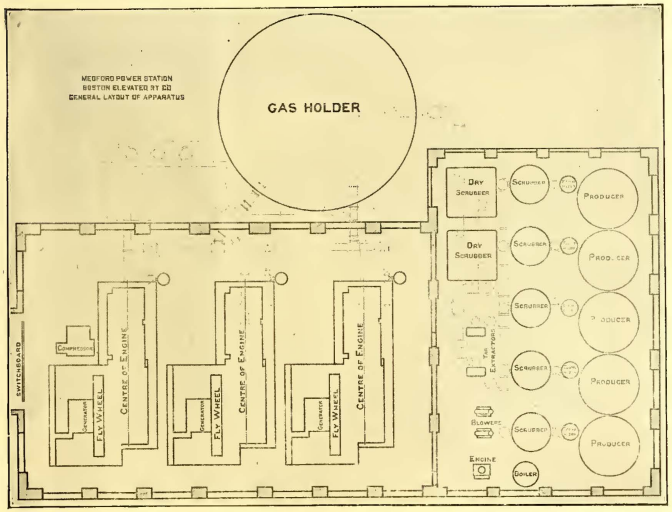
An ordinary gas man, such a man as would be considered a first-class fireman, can run at least as many horse-power of gas producers as he can of boilers. He can make a very uniform grade of gas and will get regularly very much nearer the possible efficiency from the gas producers than from the boilers. We have, however, found the Ardos CO_2 recorder of great assistance. Without it we found that the gas man would vary his CO_2 from 5 to 7 per cent, while with it he would hold it below 5 per cent. It is, of course, much more satisfactory for a man to know actually what he is doing from minute to minute than to work entirely on his judgment. The ordinary steam engineer is, of course, afraid of a gas engine, just as a stationary engineer is afraid of a locomotive, but a few months' practice should make of a good steam engine runner an equally good gas engine runner.

The handling of the water jackets is, of course, extremely simple. The problem comes in the ignition, but with a well-designed gas engine, equipped with a duplicate system of igniters, there would be little, if any, trouble.

A gas engine will hold its efficiency much better than a steam engine. With a steam engine, poorly-set or leaky valves will interfere seriously with its efficiency. With a gas engine the effect of improper ignition or valve setting, or even leaky valves, is generally either to cause a knock, therefore at once announcing



LAYOUT OF GAS AND ELECTRICAL APPARATUS IN THE SOMERVILLE POWER STATION



LAYOUT OF GAS AND ELECTRICAL APPARATUS IN THE MEDFORD POWER STATION

itself, or to reduce the output of the engine. None of these things materially affect the efficiency without showing also in other ways.

The water required is considerably less for a gas plant than for a condensing steam plant and considerably more than for a non-condensing steam plant. A non-condensing steam plant will use for all purposes from 40 to 50 lbs of water per kw-hour. A condensing steam plant will use from 20 to 30 lbs. for steam, and from 600 to 900 lbs. in the condenser per kw-hour. A gas plant will use about 200 lbs. per kw-hour.

The only two serious troubles that we have had have been premature explosion and back-firing in the engines and noisy exhaust. The exhausts we now have pretty well under control and certainly they can be made entirely unobjectionable, if not noiseless.

Premature ignition and back-firing have both given us a good deal of trouble, and on both types of engines have at times been bad, so bad as to materially reduce the engine power for the moment. This trouble is now much less than it was, and even if not further eliminated will not interfere with the regular and commercial operation of the plants.

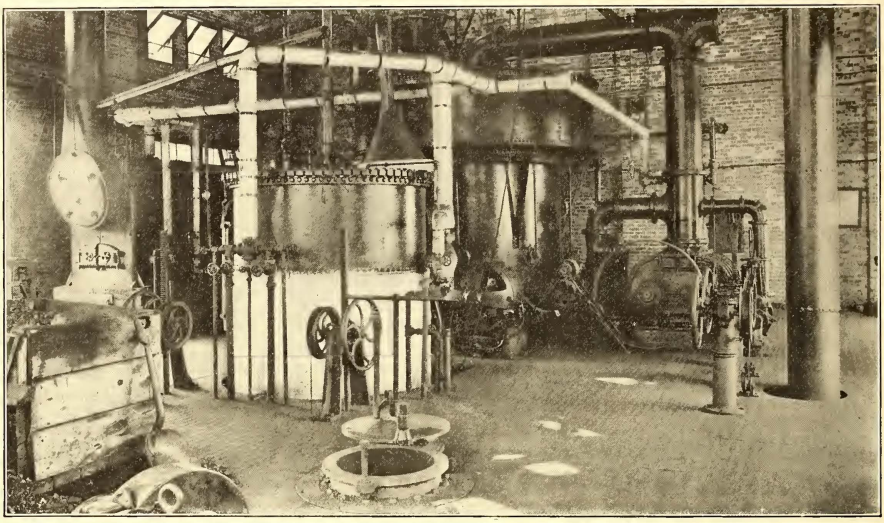
There are many forms of producers that can be used successfully with hard coal, using sizes at least as small as pea and as small as No. 1 buckwheat if it is of good quality. Soft coal cannot be used in most of the producers without the addition of tar extractors. Much soft coal has been used at the Government Testing Station at St. Louis, the tar extractors doing their work very successfully.

Soft coal can be used in down-drafts producers, such as we

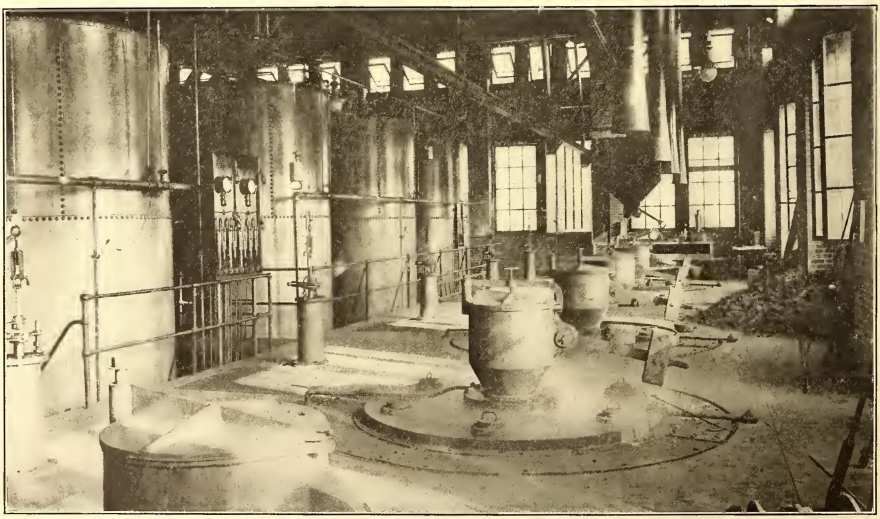
have in our Sommerville plant, without any tar getting into the gas, the tar being "cracked" on passing through the hot fires, breaking up into gas and some lamp-black, this lamp-black dirtying the scrubber water to such an extent as to make it objectionable if turned into a clear stream. This lamp-black can, however, easily be separated from the water by allowing the water to become quiescent in a comparatively small tank, the lamp-black rising to the surface.

For many years and up to very recently, gas engines have been made by comparatively small companies and in small sizes, most of them following closely the early gas engines in being single-acting and having trunk pistons. This form is not adapted to large sizes, it being expensive, if not impossible, to build, and requiring a great deal of oil. Most of the engines have been and are being built on a 4-cycle principle, there being, so far as I know, but one large manufacturer of 2-cycle engines.

In the last couple of years the large steam engine manufacturers, such as the Allis-Chalmers Company, the Snow Steam Pump Company and the Westinghouse Machine Company, have been making large gas engines, and there have been a considerable number of engines of from 2000 hp and upward run during the past year, so that to-day there is no trouble in purchasing engines of standard design in the large sizes. All three of these companies have adopted the successful designs of steam engines to the gas engines, using disc-cranks and double-acting cylinders, generally two cylinders in tandem, giving two impulses to each revolution of the crank, as with the single-cylinder steam engine. In the larger sizes they use the two-crank arrangement with the gen-



GAS PRODUCERS IN THE SOMERVILLE POWER STATION



GAS PRODUCERS IN THE MEDFORD POWER STATION

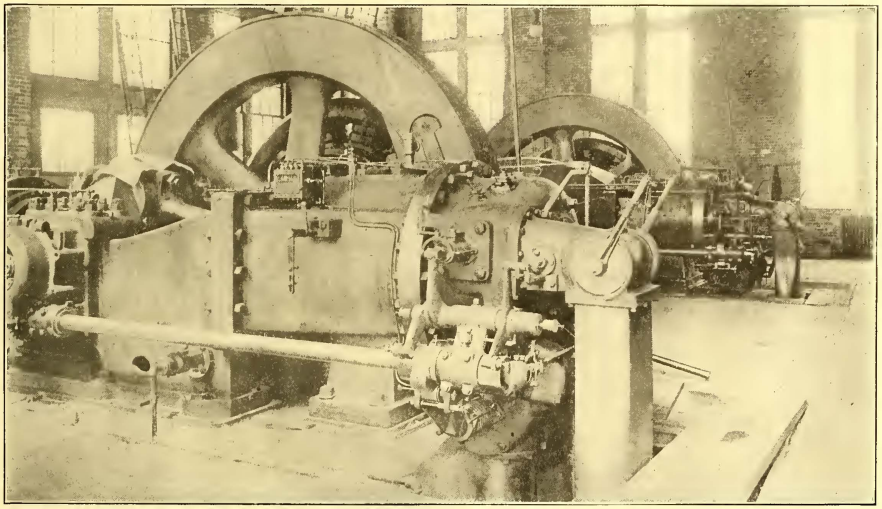
erator or fly-wheel between, each crank having two double-acting cylinders. The valves are always poppet valves, both intake and exhaust driven from a lay shaft parallel with the cylinder.

As this problem has been taken up independently by these three large and successful steam engine builders, and all have arrived at practically the same solution, it is safe to say that the gas engine of the immediate future will be of this type.

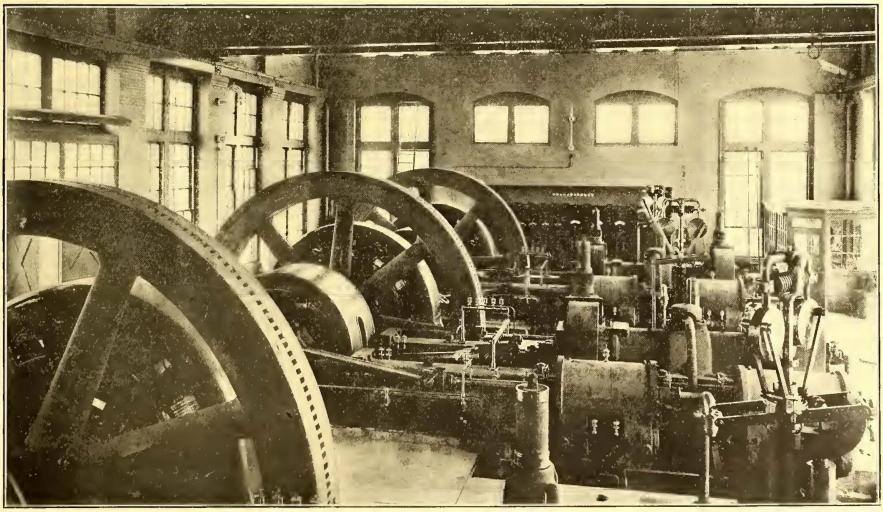
Two tar extractors.
Two sawdust purifiers.
One 15,000-cu. ft. gas holder.

Engine Room

Engines
Three single-cylinder Koerting, 2-cycle, double-acting gas engines.
Cylinder, 25½-in. diameter by 45-in. stroke.



ENGINE ROOM OF THE SOMERVILLE POWER STATION



ENGINE ROOM OF THE MEDFORD POWER STATION

MEDFORD POWER STATION

The equipment consists of the following:

Gas House

Five up-draft, water-sealed gas producers, 9 ft. in diameter.
One auxiliary steam boiler, coal fired.
One 40-hp engine, for blowers and tar extractors.
Five economizers for preheating the air for producers.
Five wet scrubbers.
Speed, 100 r. p. m.
Rated capacity, 500 brake-hp each.

Ignition
Duplicate "make-and-break" electrical igniters.
Igniter current from vibrating magnetos mounted on engine.

Generators
Three Crocker-Wheeler direct-connected railway generators.
Rated capacity, 325 kw.
Normal voltage, 500 volts. Normal amperes, 591.

Switchboard
Arranged for three generator and six feeder panels and one station panel, circuit breakers, recording wattmeters and voltmeter, etc.
Overhead Crane
The overhead crane is hand operated and supplied with an 8-ton and 1-ton hand hoist.
Water Supply
The water is supplied from three 8-in. artesian wells of an average depth of about 550 ft.
Rating
The normal rating of the station is 975 kw.
Maximum capacity, 1300 kw.

SOMERVILLE POWER STATION

The equipment consists of the following:

Gas House

Two Loomis-Pettibone soft coal down-draft producers, 9 ft. in diameter.
One regenerator boiler.
One coal-fired auxiliary boiler.
One vertical wet scrubber.
One Root exhauster, steam-driven, with electric motor as auxiliary.
One dry scrubber.
One 15,000-cu. ft. gas holder for producer gas.
One 5000-cu. ft. gas holder for water gas.

Engine Room

Engines
Two two-cylinder American-Crossley, 4-cycle gas engines.
Cylinders, 32-in. diameter by 36-in. stroke.
Speed, 140 r. p. m.
Rated capacity, 600 brake-hp each.
Generators
Two Crocker-Wheeler direct-connected railway generators.
Rated capacity, 350 kw each.
Normal voltage, 550.
Normal amperes, 636.
Ignition
Duplicate "make-and-break" electric igniters on each cylinder.
Igniter current supplied by two motor generators and a storage battery.
Switchboard
Arranged for two generators, five-feeder panels and one station panel, with circuit breakers, recording wattmeters and voltmeter, etc.
Overhead Crane
Hand operated, with an 8-ton and 1-ton hand hoist.
Water Supply
From Alewife Brook, by two-stage, centrifugal, motor-driven pumps.
Filtered by a pressure sand-filter.
Rating.
Normal rating, 700 kw.
Maximum capacity, 933 kw, or 33 per cent overload.

FOURTH DAY ECONOMY TEST—JULY 12, 1906

Duration of run (hours)		16
Kilowatt-hours output		9,489
Pounds coal in producers	13,000	
Pounds coal in boiler	.....	
Pounds of coal, total		13,000
Pounds coal per kw-hours		1.37
Load factor, elect. (per cent)		84.5
Load factor, B. hp (per cent)		72.1
Cubic feet mixed gas		1,397,000
Cubic feet water gas		50,500
Cubic feet producer gas		1,346,500
Per cent water gas		3.61
Cubic feet mixed gas per hour		87,400
Cubic feet mixed gas per kw-hour		147.3
Pounds coal		107.5
Mixed gas, B. T. U.	High	126.5
Mixed gas, B. T. U.	Low	122.5
Water gas, B. T. U.	High	288.7
Water gas, B. T. U.	Low	269.5
Producers gas, B. T. U.	High	120.8
Producers gas, B. T. U.	Low	117.0
Cubic feet water—7 a. m.—11 p. m.		32,045
Water-cooled valves	1,038	
Economizer	277	
Scrubber	7,445	
Engines and waste	23,285	
		32,045

THIRD DAY ECONOMY TEST—JULY 11, 1906

	Coal Analysis		
	As Received	Dry Coal	Combustibles
Moisture	2.30	.....	.....
Volatile matter	18.48	18.90	20.25
Fixed carbon	72.79	74.52	79.75
Ash	6.43	6.58	.....
B. T. U. per pound	14.030	14.360	15.380

THIRD AND FOURTH DAY ECONOMY TEST—JULY 11-12, 1906

	Mixed-Gas Analysis		
Date	June 11, 1906	June 11, 1906	June 12, 1906
Time	5.05 p. m.	8.25 p. m.	5.12 p. m.
CO_2	3.5	3.0	3.6
O	.2	.2	.2
CO	26.9	27.4	27.2
CH_4	1.2	1.0	1.1
H	9.9	9.1	8.5
N	58.3	59.3	59.4
B. T. U. at 60 degs. F.	132.1	133.8	127.5

EXHAUST-GAS ANALYSIS—JULY 31, 1906

Sample Taken from Elbow at Muffler of Engine

No. 1.—A end	Per Cent
CO_2	11.7 volume
O	13.0 volume
CO	trace
N	75.3 volume
	100.0

This sample shows that an excess of air of 65 per cent was being used at time sample was taken.

RELATIVE ECONOMY OF TURBINES AND ENGINES AT VARYING PERCENTAGES OF RATING

BY WALTER GOODENOUGH,
Engineering Department, Stone & Webster, Boston, Mass.

It has become evident to most of us, from time to time, that what is needed in the power station is not so much more economical prime movers, but rather more intensive operation of the particular type of machinery which we now have. This paper has, therefore, been made with the idea that it might bring interesting discussion from many and be of assistance to some of the companies.

The assumption that fixed charges are spread over the whole 24 hours, and that the machine operates during the full 24 hours is, of course, not correct; but in the present instance where it is desired to bring out, rather the effect of the combination of fuel and fixed charge costs, instead of actual operating costs, this assumption is considered to be well taken. On this basis characteristic curves for engine-driven and turbine-driven units are produced.

It is assumed for purpose of this paper that each plant is of one unit running 24 hours per day, and on this basis fuel costs and fixed charges per kw-hour are plotted individually and then combined. No other costs have been taken into consideration, as the addition or subtraction of such constant costs as labor, heat losses, etc., make little or no difference in the characteristics of the curves until these increases or decreases have assumed a very large size. It is further assumed that the labor costs for a single engine-driven unit will be fully as low as for a turbine, and this assumption has also been made for the maintenance of the respective machines. It is taken also that the extra heat turned into the feed-water by turbine auxiliaries over those of engine auxiliaries will offset the greater amount of heat used in the work of driving the larger turbine auxiliaries.

In making the curve of fuel cost, the price of coal is assumed at $2 per ton, and the evaporation per pound of coal as 7½ lbs. of water. On this basis, 1000 lbs. of water evaporated will cost 13½ cents.

In determining the fixed charges, the following percentages have been taken for engine-driven units:

	Per Cent
Interest	5
Depreciation	12
Maintenance	1
Taxes	1
Total	19

For the same charges for turbine-driven units the percentages have been taken:

	Per Cent
Interest	5
Depreciation	10
Maintenance	1
Taxes	1
Total	17

In the above tabulation, interest remains standard at 5 per cent; the maintenance remains the same for both turbine and

engine, as any good engine unit will not have a higher maintenance of itself and its auxiliaries than a turbine with its much more numerous auxiliaries. In considering depreciation, amortization has been neglected, and the depreciation deliberately placed high.

In the present state of the art we can expect to see developed in the near future prime movers and fluids generators (including the pieces of apparatus now known as boilers and gas producers) of such an increased efficiency that it will become necessary, for many reasons, to abandon our present units within a few years. We are assured by the makers of turbines that they are still exploring the field, and most of us have visions of high economy gas-driven machinery at no distant date. So unsettled are the conceptions for the future of commercial economy in power generation that it cannot be but wise to place a high depreciation on our present machinery. Competition, local disturbances through municipal ownership, agitation and other commercial reasons will demand more than ever the supersedence of present-day designs for new ones of higher efficiency. The exact form in which "depreciation" is applied does not matter, the basic fact remains that machinery does depreciate, and the fact is not less true that the genus "stockholder" pays the depreciation. He may do it by default of dividends, held in a sinking fund by a careful administration, or by means of assessments, of interest on mortgages or bonds.

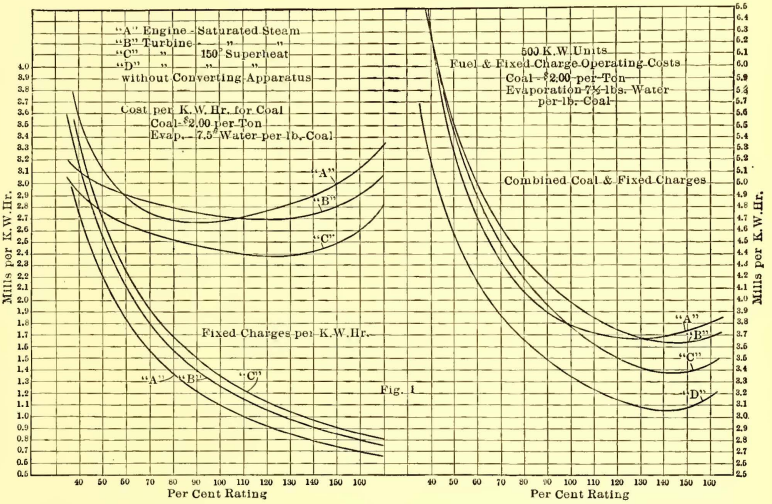


FIG. 1.—GRAPHIC COMPARISON OF TURBINE AND ENGINE COSTS

In regard to the first cost of the machinery under discussion it has been assumed that with the 500-kw units the system in use will be 500 volts direct current. It is also assumed that the engine units will have drect-current generators, and the turbine units alternating-current generators, requiring converting apparatus. It is further assumed that the engine will work with saturated steam and that the turbine will use superheated steam. We, therefore, assume the following costs for the engine unit:

	Per Kw
Engine and generator	$45.00
Condensing apparatus	4.00
Foundations	3.00
Total	$52.00

On the same basis we assume that the turbine with saturated steam would cost as follows:

	Per Kw
Turbine and generator	$36.00
Condensing apparatus	6.00
Foundation	1.00
Motor generator apparatus and switchboard	22.00
Total	$65.00

In order, however, that full operating value from the standpoint of steam economy may be obtained from the turbine, it is necessary to install with our boilers some superheaters, and for this additional cost we should apply $4.25 per kw, making a grand total for the turbine of $69.25.

In order to show the effect upon the combined kw-hour cost of having to add converting apparatus, curve "D" in Fig. 1 has been made, based on a total first cost of $69.25, less $22..

For 1500 kw-units it has been assumed that both the engine-driven and turbine-driven unit will generate alternating current, and on this basis there have been assumed the following costs:

	Per Kw
Engine and generator	$35.00
Condensing apparatus	2.25
Foundations	2.25
Total	$39.50

On the same basis as the above we have:

	Per Kw
Turbine and generator	$28.00
Condensing apparatus	5.00
Foundations	.50
Superheater and piping	4.00
Total	$37.50

In the case of curves for 1500-kw units, it has been assumed, without question, that the engine will run with saturated steam and the turbine with superheated steam.

On the basis of all-sized units, operating alternating current, the 500-kw turbine makes quite a little better showing of rated load efficiency against the engine unit than the 1500-kw size of turbine. The author would, however, suggest that the 1500-kw unit is probably the one size where conditions of total cost per kilowatt, fuel and fixed charges come nearest those of the engine. For all sizes above 1500 kw the combined cost of the turbine unit draws rapidly away from the engine unit in the direction of lower cost, and it might be suggested here that if there were any one spot where engine builders desired particularly to apply refinements to their designs in the way of larger cylinder ratios, rejacketing, reheating and superheating, the 1500-kw size would undoubtedly prove the most fruitful for them. There is some question, however, as to whether the increased economies in steam consumption they might obtain would overcome the increased fixed charge cost due to greater expenditure to obtain these results.

As stated in the first part of this paper, it is of considerably greater importance in the immediate present to the station manager to consider how he may obtain the greatest economy from the units which he has, rather than where he can buy units having half a pound better steam consumption than what he has.

If we look at Fig. 1, it will be noted that the fuel cost for the 500-kw engine unit is at its lowest point at 90 per cent rating, while with the turbine unit this best fuel cost comes near to the 120 per cent rating, both with and without superheat. Now, if we add to this the fixed charges per kw-hour, we see in our engine unit that the point of maximum economy is moved from 90 per cent rating to 125 per cent rating. Also, in our turbine units the point of maximum economy, when converting apparatus is included, is moved up to about 145 per cent rating from 120 per cent. When the converting apparatus fixed charge is not

included, we find the high point of total economy has dropped back to around 140 per cent.

From these characteristic curves, therefore, it becomes quite apparent that we cannot carry out steady loads per unit any too near 100 per cent rating. It would not, of course, appeal to the average careful station manager to operate his individual units at continuous loads above 100 per cent. Consideration has to be taken of the ability of the generator to stand continuous overload, and a margin has also to be provided for suddenly applied overloads or swings. It would seem, however, that there should be no valid excuse in a well-managed plant for not maintaining the loads as near as possible to 100 per cent rating of each individual machine. It is well known that engine builders have, for quite a number of years, built their machinery, for point of maximum economy, nearer to 75 per cent rating than 100 per cent rating; they assuming that the loads in a station would always be under, rather than up to or over 100 per cent; and, therefore, they have put their machinery where it would show up the best under loads which the average engineer feels he can run. It is apparent, however, from these curves that the true economy of the plant is by no means the steam economy of the plant, and it is also seen that the engine builder, on the basis of steam economy alone, did not shove his point of best economy far enough back,

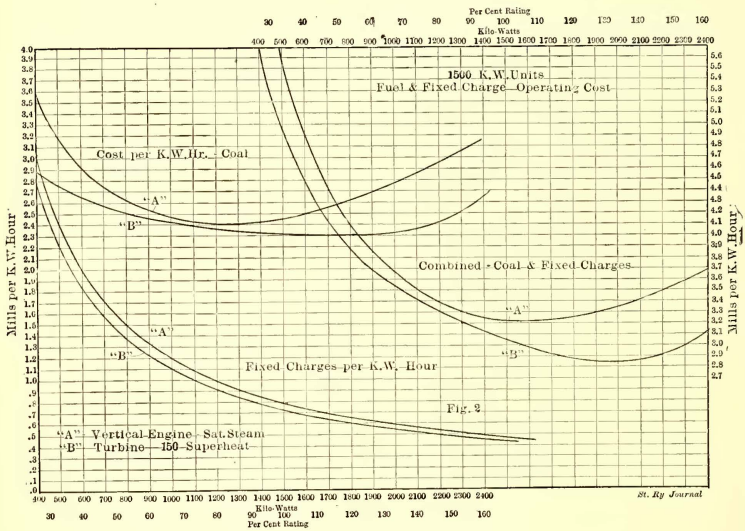


Fig. 2

FIG. 2.—GRAPHIC COMPARISON OF TURBINE AND ENGINE COSTS

after all. On the other hand, it appears that the turbine builder has not yet reached consideration of this point, and he is building his turbine for a rating which carries the point of combined economy to considerably over 100 per cent rating and close to the point where the total economy begins to fall off sharply, and the capacity of the machine is being rapidly absorbed. In the particular instance of the 500-kw units, it would seem that the engine overload capacity was not too far in excess of its generator capacity; but in the case of turbine it is apparent that the size of the turbine for the same size generator should be considerably decreased and means taken to insure, after such decrease, that overloads can be readily carried by the machine. Such changes as those would then bring the point of maximum total economy back to the place where it is actually possible to operate the machines under steady loads in the average power station furnishing current for a street railway.

However, the turbine builder has not supplied us with this very desirable machine, and it, therefore, becomes necessary for us to make the best of what we have. It would seem wise to fix as high as possible the loads at which each individual machine in the station should operate, and then maintain these loads as continuously as possible. When variations have to be taken they should naturally be taken by increasing the load on the machines already in service, rather than to put in another unit and underload it, or all of the units in service. There is a question of reliability and safety of service which comes in here, and which the station manager will, of course, have to settle according to the character of his load and the number and size of his units.

The foregoing naturally brings up the question of selection of the size of units in new developments or renewals. The end of all construction should be the minimum combined cost per kw-hour of operation, and, therefore, it behoves us in selecting our new units that we study carefully not only the immediate loads to be applied, but also the expected future loads. It is to be suggested that many managers can, with good success, chart their daily load and fix almost precisely, from day to day, the time when each unit shall enter upon its work and the load which it shall carry. The average station engineer has too limited a view, from reasons of training, to take any initiative of this sort. He will often require considerable persuasion to get him over the fear of running his machinery too hard. It is the author's general experience, however, that with someone to start such a man authoritatively along the lines of better economy, that he becomes, not only anxious to make a better showing, but his pride in such showing is very marked.

The general statement which has been made that turbines have a flatter load curve than engines is decidedly misleading when considered from the standpoint of total cost per kw-hour. Inspection of the combined curves on both Figs. 1 and 2 show that at 100 per cent rating the rate of change in cost per kw-hour of operating the turbine is decidedly greater than for the engine. It is seen from this curve that the engine, with its point of steam economy at 85 per cent or 90 per cent rating, has at 100 per cent rating a much flatter curve of total economy. If we will inspect curve "D," Fig. 1, we will see that for an increase in load, from 75 per cent rating to 100 per cent rating, the increase in economy on the basis of which this curve is made will be 11 per cent. Of this 11 per cent gain in total cost the steam economy gain is only 4.7 per cent, while the fixed charge gain is 23 per cent, or four times as much gain as in steam cost. These percentages, of course, will bear quite some changing under different conditions, but it must be borne in mind that the characteristics of the curves will remain very generally the same. Again, as stated in the first part of the paper, it is not strictly correct to assume that the unit is to run 24 hours a day at a certain load. However, it should be noted that applying the fixed charges to the unit for the actual number of hours run each day will increase these fixed charges per kw-hour, and more than ever increased its effect on the total combined economy, shoving the point of maximum economy still further up into the overloads. The decreasing of the fixed charges per kw-hour means, however, an increasing of the steepness of the fixed charge curve below 100 per cent rating, thereby accentuating from the other standpoint the marked effect upon total costs which fixed charges have at all ratings below 100 per cent or thereabouts.

The effect of the increase in the cost of coal, while not affecting the strict character of the curve of cost per kw-hour, does somewhat flatten out the inclined portions of the curve.

Thus it may be truthfully said that the curves "A," "B," "C," and "D" will at all times retain their characteristic forms, and that being the case, whatever has been shown in this paper as to relative costs for different percentages of full load is very closely true. The increase or decrease of either fuel cost or fixed charge cost changing but very slightly the relation of the individual fuel and fixed charge curves to the combined curve.

The point has been raised that, after a plant is once installed the fixed charges do not enter into the economy of operation, and

that, therefore, the plant should be run at its lowest steam consumption. If, however, it is legitimate and necessary to figure fixed charges per kw-hour in preliminary estimates, it appears to the author that they should be considered when the plant is in operation, for two reasons.

First—The operating reason, that with the load usually carried by operating engineer, full value is not being obtained from the investment. A monthly report which shows fixed charges per kw-hour generated should be of immense value to the operating superintendent in determining whether his plant is receiving the particular and discriminating attention which such a large investment warrants.

Second—The investment reason, that a machine which has the lowest combined cost per kw-hour at the individual loading that is carried, is the most desirable to continue in the installation. Manifestly a machine which has a combined kw-hour cost lowest at 100 per cent rating is better than one having its lowest cost at 140 per cent rating. The first machine will probably have smaller steam end for the same generator than the second unit. By adding automatic overload devices, costing little money, to the first machine it can be made to operate up to the full overload capacity of the generator in taking care of peaks of short duration.

The author would point out that this is not a consideration of station load factors, but rather a consideration of the economy in operation of individual units, and also economy in their selection as affected by type and design.

In conclusion, the author would additionally point out that the gains indicated herein for turbine and engines are, to a greater or less extent, true for all other station apparatus, and perhaps no more true than in the case of boilers whose load and operation seem equally as far buried under misapprehension as are the generating units.

ECONOMY IN CAR EQUIPMENT, WEIGHTS AND SCHEDULES

BY E. H. ANDERSON,
Schenectady, N. Y.

The intent of this paper is to deal with the dynamic features of car service and its relation or effect on the cost of that service. It is not to be expected that the values given apply accurately to all or any railway system, but serve to illustrate the effect of the dynamic on the economic.

By close examination into the service it may be possible to rearrange the equipment, speed and size of cars, actually to give to the public a greater schedule speed at a decreased cost per car or passenger mile. Since the real profit depends upon a small portion of the difference between operating cost and money taken in, it is worth while to closely investigate to see if a small saving cannot be accomplished and thereby largely increase the real profit.

Fig. 1 shows, in the usual form, the characteristics of a standard 40-hp railway motor. The gear is such as used on city service cars. The rating of the motor is 72 amps. In starting the car usually this rating of 72 amps. taken per motor, giving a tractive effort of approximately 1400 lbs. Assuming an 18-ton single-track car, loaded and equipped with two of these motors, the tractive effort per ton will be 156 lbs., deducting friction, say of 20 lbs., gives an accelerating force of 136 lbs. per ton, equivalent to 1.5 m. p. h. per second increase in speed.

Theoretically, the above rate of acceleration is continued by various connections of controller until the full voltage is applied on the motors, the speed of car at that time being 10.25 m. p. h. The motors then accelerate on the automatic characteristic of the motor, and the speed increasing and the tractive effort decreasing, until the tractive effort is sufficient to overcome only the friction of the car, the car then continuing at this speed until power is shut off or brakes applied. This maximum speed will occur when the tractive effort, assuming friction 30 lbs. per ton is 180 lbs. per motor. By reference to Fig. 1 it will be seen that the speed at this tractive effort is approximately 20 m. p. h. on 500 volts applied to the motors.

Fig. 2 shows, pictorially, the speed and energy operation of an 18-ton car equipped with motors having the characteristics as shown in Fig. 1.

The abscissæ are times in seconds, and the ordinates speed in m. p. h. and kilowatt input of car. It is evident that the area enclosed by the speed-time curve is the distance traveled by the car, similarly the area of the kilowatt-time curve is the energy taken to propel the car over the particular distance in the particular time.

Fig. 3 shows the operating characteristics of the above referred to car with various distances between stops.

The abscissæ are distances in feet between stops, the ordinates

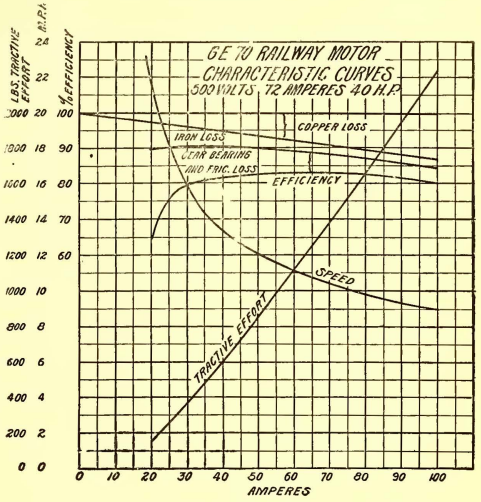


FIG. 1.—CHARACTERISTIC CURVES OF GE-70 RAILWAY MOTOR

being m. p. h. schedule speed, watt-hours per ton-mile and average input per ton.

By reference to Fig. 3:

800 FT. BETWEEN STOPS

Schedule speed, miles per hour	10.4
Watt-hours per ton-mile	131
Average kilowatt input per ton	1.35

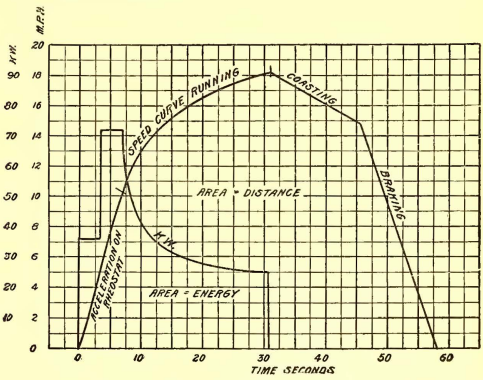


FIG. 2.—SPEED TIME CURVE OF 18-TON CAR

2000 FT. BETWEEN STOPS

Schedule speed, miles per hour	15
Watt-hours per ton-mile	88
Average kilowatt input per ton	1.33

4000 FT. BETWEEN STOPS

Schedule speed, miles per hour	18.2
Watt-hour per ton-mile	68
Average kilowatt input per ton	1.25

The above shows the actual decrease in watt-hours per ton-mile and increase in schedule speed as the distances between stops are greater. The point to which attention is directed is that with a great variation in the distance between stops, the average input

per ton is constant. Thus on long-distance runs the cost of power per car mile is reduced in the same proportion as the schedule speed is increased.

In all the foregoing a normal acceleration of 1.5 m. p. h. per second was used, and the speed characteristic as shown in Fig. 1.

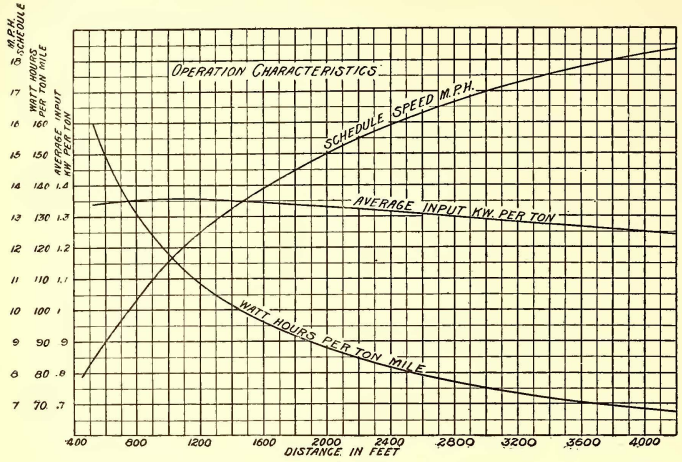


FIG. 3.—OPERATION CHARACTERISTICS

Fig. 4 shows the energy and power for a constant schedule over a constant distance of 1000 ft., the variation being in pounds per ton acceleration. At 70 lbs. per ton acceleration the horse-power rating of motors per ton of car is 2.7, and the energy 102 watt-hours per ton mile. At 150 lbs. acceleration, the horse-power rating of motors per ton of car is 3.4, energy 85 watt-hours per ton mile. At 200 lbs. per ton acceleration, power 4.1, energy 83. There is a saving in energy from 102 to 83 watt-hours per ton mile by changing from 2.7 to 3.4 hp per ton.

By reference to Fig. 4 it will be seen that higher rates of acceleration than 150 lbs. increase the horse-power rating of the equipment without really making any substantial decrease in energy required. At an acceleration of 100 lbs., while the size of the equipment may be decreased some, there is a material increase in the energy required to operate the car.

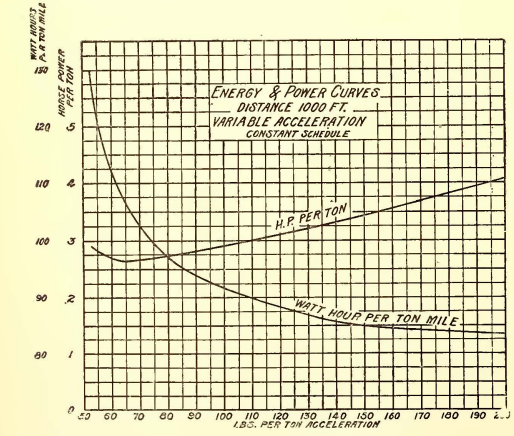


FIG. 4.—ENERGY AND POWER CURVES

Fig. 5 shows the horse-power per ton and the energy required to make various schedule speeds over a definite distance. Making 8 m. p. h. schedule, the power is 1.8 hp per ton, and the energy 72 watt-hours per ton mile. Making 10 m. p. h. schedule, the power of motors is 3.25 hp per ton, energy 94 watt-hours per ton mile. Making 12 m. p. h. schedule, the power is 6.7 hp per ton, energy 135 watt-hours per ton mile.

By inspection of Fig. 5 it will be seen that the power and energy increase at an enormous rate between a schedule speed at 12 and 13 m. p. h., and becomes very large as you approach the limit of physical possibility.

Fig. 6 shows the effect of accelerating at 100 lbs. per ton, as compared to the acceleration of 150 lbs. per ton.

By examination of the curves it will be seen that the energy input per ton is smaller, and the schedule speed higher with the acceleration of 150 lbs. per ton. The equipment, car weight and conditions are identical in every respect, and while the difference may seem small at first, it is well worth serious consideration.

With 800 ft. between stops, the schedule is 5 per cent greater and the energy 1 per cent or 2 per cent less with the acceleration of 150 lbs. per ton, thus for the same ton miles there is a reduction of approximately 6 per cent in energy, cost and wages of motormen and conductor (platform cost), which in large systems is a very considerable item. The difference in favor of the 150 lbs. per ton acceleration becomes a greater per cent as the service is more and more congested, and the distance between stops less and less. Besides the saving indicated, a comparison of rates of acceleration points strongly to the kind of equipment to be desired.

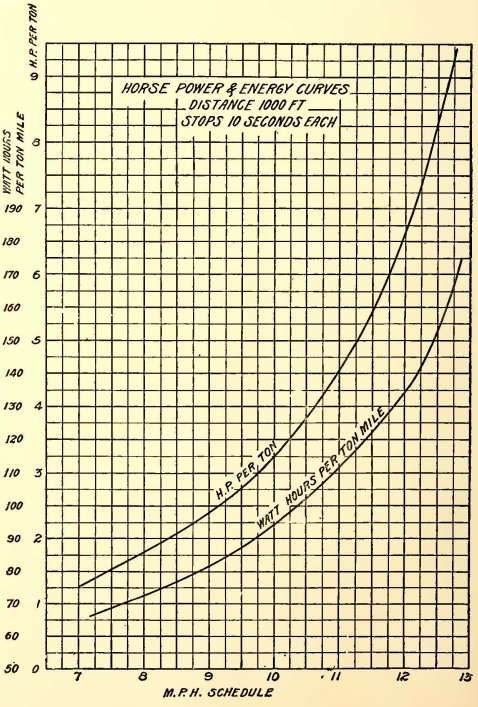


FIG. 5.—HORSE-POWER AND ENERGY CURVES

Due to ordinary street conditions, the coefficient of traction is much reduced as compared to the clean, dry rail. It has been found that single motors on single-truck cars or double motors on double-truck cars are greatly hampered on small grades, and well nigh inoperative at times, due to the low coefficient of traction caused by slimy or snowy condition of track, the proper equipment is where every rolling point is a pulling point. Where all the track is on a private right of way, and the rails can extend above the surface of the ground so as to be kept clean, and grades are small, such as steam railway conditions, half of the rolling points equipped as pulling points will be undoubtedly sufficient.

Fig. 7 shows the effect of different speed equipment on the schedule speed and cost per car mile. The schedule speeds are net, including 10-second stops. The cost per car mile is based upon energy at 1.5 per kilowatt-hour, 50 cents per hour platform labor, and $500 per car fixed charges. This latter is approximately 10 per cent of the investment in the car. The costs which go directly as car miles have been neglected, as they do not seriously affect the differences between the cost per car mile for the various conditions. The car has been assumed to be in service 12 hours per day for 350 days per year.

It is not to be expected that these curves apply to all or any one case, but serve to give a picture of the relations between cost per mile and schedule speed, with the different speed equipment and different distances between stops.

By inspection of the curves it will be seen that the cost per car mile of the equipment for the maximum speed of 20 m. p. h. is the same at 1600 ft. between stops as the equipment, which has a maximum speed of 24 m. p. h. The schedule speed, however, is 7 or 8 per cent higher with the higher speed equipment. At 2800 ft. between stops, the cost per car mile is the same for the equipment, having a maximum speed of 20 m. p. h. and 28 m. p. h., whereas the schedule speed is 18 per cent higher with the higher speed equipment.

Examining Fig. 7, at short distances between stops, it will be seen that the slightly greater schedule of the higher speed equipment is maintained at an increase of expense per car mile. Evidently the better equipment is the one with the slower maximum speed, and as has been seen in Fig. 6, the one of greater accelerating power. Examining Fig. 7, at 4000 ft. between stops, the cost per car mile is least with the maximum speed equipment at 28 m. p. h., while the schedule speed is decidedly higher. It will depend upon the distance between stops, cost of energy and fixed charges, just what speed equipment will give the least possible cost per car mile, by a little study and the facts in hand the proper speed equipment can be arrived at with considerable degree of accuracy.

By closely examining a composite service of city and interurban running it is also possible to determine closely the proper speed equipment for the combination service which will have the least cost per car mile.

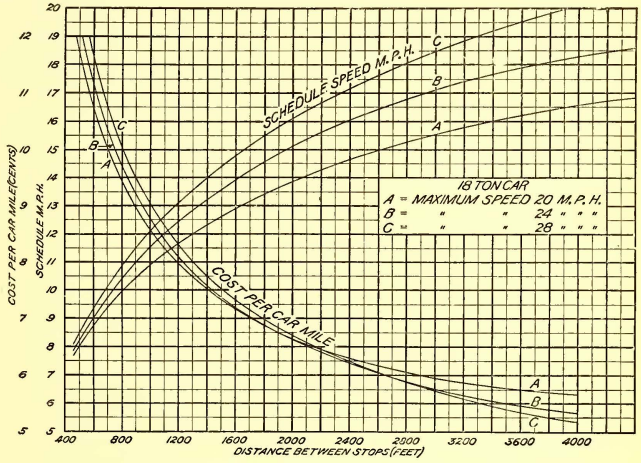


FIG. 7.—SCHEDULE SPEED AND COST PER CAR-MILE CURVES

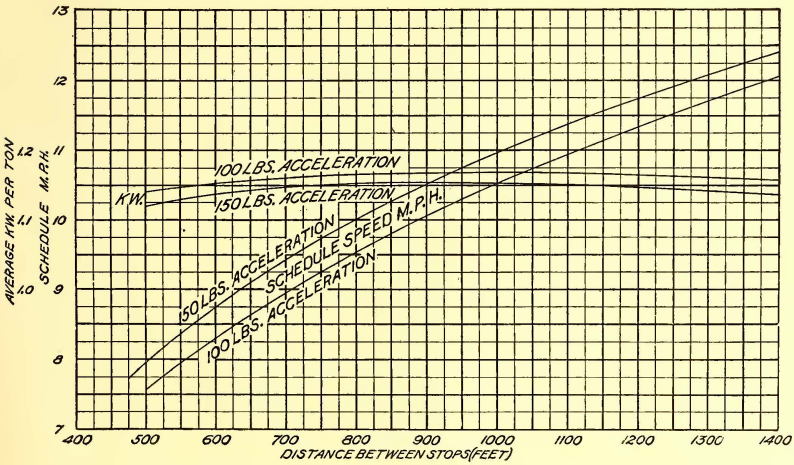


FIG. 6.—SCHEDULE SPEED AND ACCELERATION CURVES

Considering the curves in Fig. 7, it will be seen that the cost per car mile for short runs is high, whereas for long runs between stops the cost per car mile is very much lower.

Should the earnings per seat mile be approximately the same for the interurban car as for the city car, the interurban railway should pay handsome dividends, whereas the city system will struggle for life.

Should the power cost be greater than that which I have assumed, the cost curves will be higher and cross at a greater distance between stops. Should the fixed charges, such as platform labor, interest, depreciation and taxes on cars and car houses, be greater, the cost per car mile will be higher, and the curves of cost will cross each other at a shorter distance between stops, thus making the higher speed equipment more necessary for the longer runs. While the above facts are in accord with the common sense and experience, it is gratifying to see the conclusion can be expressed in mathematical form.

For smaller cars the energy is smaller and the fixed charges the same, thus the cost per car mile will be lower for the smaller car, but much higher per seat mile, the proper speed for the smaller cars should then be high. Conversely, where the car is large the economic speed will be lower.

The above illustrates strongly that the largest car which can be run, and the proper frequency of cars maintained, will give the least cost per seat or passenger mile.

REPORT OF COMMITTEE OF ENGINEERING ASSOCIATION ON MAINTENANCE AND INSPECTION OF ELECTRICAL EQUIPMENT

Presented by WILLIAM PESTELL (Chairman), J. S. DOYLE and W. D. WRIGHT

There are various systems and methods provided for the maintenance and inspection of electrical equipments throughout the country, all of which are designed with a view of meeting local conditions. One of these was treated at great length in an able paper at our St. Louis Convention by Mr. John Lindall, superintendent motive power and machinery, Boston Elevated Railway Company, Boston, Mass.

The reliability of operation and economy in maintenance of electrical equipments are dependent primarily upon the selection of apparatus to meet the conditions of service, to some extent upon the methods of installation, and particularly upon the system of maintenance and inspection. The engineering staff of the Interborough Rapid Transit Company has been selected with the greatest possible care, and no expense or labor has been avoided by them in the selection of the most efficient apparatus for this extremely severe service. This company is to be credited with taking the initiative with respect to reducing fire risks on electrically equipped cars, both in semi-fireproofing the wooden type through the use of composite asbestos, and also in providing an all-steel type of car. This latter is original and a decided step in the advancement of the art.

The next in order as bearing upon the maintenance and inspection of electrical equipments is the method in which the various apparatus constituting the equipment is placed upon the cars. It is not unusual, even at this late date, to find railway companies disregarding the proper installation of equipments, although some of the companies, we are glad to say, have become alive to the importance of this feature of operation and are doing very creditable work.

The installation of equipments on the Interborough Company's cars has been completely designed by its engineering staff and applied from working drawings, which is, we believe, an innovation in the method of performing such work, for usually this feature is left to the discretion of the shop foreman. As a result a great deal of study was devoted to all the details of car equipment, and the apparatus was applied in a most approved mechanical fashion, an absolute standard being maintained. This has proved economical both in the cost of installation and of maintenance.

The methods employed in the maintenance and inspection of electrical equipment of this company were, in the beginning, similar in many respects to other systems of the kind, but have been altered from time to time for the purpose of introducing economies and increasing the reliability of the service, for the latter, as many of you are aware, is vitally important in the greatly congested districts of the metropolis. Formerly the car equipments were inspected on a three and one-half to four-day period, and the general repairs and overhauling were conducted within a period of from twelve to fourteen months, without any regard in either case to the amount of work performed by individual cars.

The first improvement was accomplished by introducing a merit system between the shop forces, which reduced the cost of labor 31.7 per cent on the Manhattan division, and 29 per cent on the Subway division, and also had a material effect upon improving the reliability of service. This system provides for an itemized comparison of the cost of labor and material between the five inspection shops each month, together with a bulletin showing the number and character of delays to service, from all of which the ability of the various foremen and inspection forces is determined. The object of this is constantly to maintain an efficient inspection force, which is, as all of you are aware, rather difficult, but we are glad to state that this scheme has been unusually successful. The most competent foremen receive an increase in salary, and the incompetents are either reduced in rank or dismissed from the service of the company.

The greatest publicity is given to these monthly recapitulations, so that all the officers of the company and minor foremen of the department are informed as to the relative merits or demerits of each inspection shop force, and it has thus been found that the old-fashioned methods in vogue of foremen taking it easy after appointment quickly disappear, and instead the foremen are "on the job" constantly, so to speak. We find also that they are unusually well posted on the expenditures of their department, which is rather unusual, and also that they are greatly interested in the reliability of the train service.

As a further step in maintaining an efficient inspection organization, a simple system was devised which provides for recording the name of each employee responsible for each item of work, thus impressing him with his share of responsibility and enabling the foreman to maintain a constant check on his men.

There is not much to be said of the old method of general repairs except that accurate monthly records are kept, showing comparisons between similar classes of work performed on various cars which enable the foremen to appreciate the value of expenditures for both labor and material and to avoid exceeding predetermined amounts.

The improvements since introduced were the placing of both the inspection and overhauling of equipments on a mileage or measurable basis, which, so far, we are glad to state, has given very gratifying results. The accompanying table shows that the old method was, as stated, to inspect the cars every three and one-half to four days, which, upon investigation, we found gave an average of 450 miles per car. Through a series of experiments it was found that this mileage could be increased to 1000 miles without affecting the reliability of service, which reduced the volume of inspection work more than 50 per cent, and the amount of expenditure 21.5 per cent on the Manhattan division and 31.9 per cent on the Subway division.

The average mileage of general repair cars in service during a period from twelve to fourteen months under the old system was found to be 53,000 miles, the maximum 90,000 miles, and the minimum 35,000 miles, from which it was decided to adopt an average of 65,000 miles between general repairs as an experiment, thus making a reduction of 18 per cent in the expenditure for this purpose.

To reduce the maximum and increase the minimum mileage of general repair cars, and thus equalize the length of time in service between general repairs, a system was provided for readjusting the cars on the train schedule each month.

The inspection mileage of car equipments is kept without additional expenditure by the train clerks of the transportation department, and the general repair mileage is obtained from the mileage department.

The items of oiling motors, journals, compressors, etc., together with the wear of carbons, brake-shoes and other parts, are based on mileage comparison, and it has been found, for instance, that the former methods of oiling journals and motor axle bearings each month at from 3000 to 4000 miles could be extended to 10,000 miles with satisfactory results.

There is maintained at all times a complete record of failures of all apparatus, and if it is found that any failure reaches an abnormal state, such failures are capitalized, and the necessary expenditures made for corrections in design, or the purchase of new apparatus, which is not only a step in the direction of maintaining the most efficient service, but has also proven the most economical method.

In addition to these alterations, we are at present experimenting with a piece-work system for the purpose of providing a means of increasing the employees' wages, thus obtaining a better class of men, and also to effect further economies. So far this has proven very satisfactory, for the amounts paid the employees affected have increased an average of 10 per cent, while the cost of the work has been reduced 26 per cent

SUMMARY OF INSPECTION WORK

Daily Average Cars Inspected	Mileage System	3½-Day System	Reduction in Volume of Work, Per Cent
Motor cars, Manhattan	121	232	47.8
Trailer cars, Manhattan	47	135	65.2
Motor cars, subway	53	110	51.8
Trailer cars, subway	29	82	64.6
Av. Mileage Between Inspections			**Increase in Mileage, Per Cent**
Motor cars, Manhattan	967.57	484.47	97.6
Trailer cars, Manhattan	1,422.44	450.14	216.0
Motor cars, subway	1,014.14	419.04	142.0
Trailer cars, subway	1,459.30	380.67	282.3
Av. Days Out Between Inspections			**Increase of Time in Service, Per Cent**
Motor cars, Manhattan	6.99	3.5	99.7
Trailer cars, Manhattan	11.06	3.5	216.0
Motor cars, subway	7.26	3.0	142.0
Trailer cars, subway	11.50	3.0	283.0

Av. Max. Days Between Inspections			Increase of Time in Service, Per Cent
Motor cars, Manhattan	15.17	8.0	89.6
Trailer cars, Manhattan	19.00	8.0	137.5
Motor cars, subway	12.38	5.0	147.6
Trailer cars, subway	15.83	5.0	216.6

REPORT OF THE ENGINEERING ASSOCIATION'S COMMITTEE ON STANDARDIZATION

BY H. WALLERSTEDT, Chairman; H. A. BENEDICT, W. H. EVANS, H. B. FLEMING, J. M. LARNED, F. H. LINCOLN, PAUL WINSOR

The utter lack of standardization of materials was forcibly brought to light in the tabulation of the answers to questions submitted by the committee on maintenance and inspection of electrical equipment in the course of its investigations during the year 1905. The immediate result was the appointment of a committee on standardization at the Philadelphia convention.

Because of the great amount of ground it will be necessary to cover ultimately, the committee decided at the beginning of its work that the immediate investigation should be limited to those questions which have appeared to the committee as being of the greatest importance and most in need of early adjustment. It was further considered wise to confine the investigations to such parts and dimensions of the particular equipment under consideration as would make it interchangeable, leaving to the individual worker and seeker after improvement as wide a field of operation as circumstances will permit.

The committee has also deemed it advisable to avoid designs involving patents, and, for the present at least, no attention will be given to the chemical analysis of the material contained in the parts to be standardized.

After a careful consideration of the subject, it was decided to confine the work of the year to the standardization of brake-shoes, flange and tread of wheels, rails and journals and journal boxes. It will be observed that these parts are more or less dependent upon (and bear a certain relation to) each other. As preliminary steps toward standardization, it has been considered necessary to prepare data sheets for the purpose of collecting such data and drawings as would enable the committee to base its future recommendations upon the experience and practice of the various street and interurban railways. Copies of these data sheets, together with copies of the circular letters which accompanied them, will be found in the appendix which forms a part of this report.

Considerable thought and time have been given to the preparation of these data sheets, and it has been the endeavor of the committee to ask for only such information as would bear directly upon the subject under consideration.

It is gratifying to be able to report that many manufacturers have shown a great deal of interest in the work set before the committee, and that they have given very material aid by the sending of their representatives to our conferences in New York City. The correspondence pertaining to this work, which has been very large, and the printing and distribution of the data sheets and circular letters have been carried out through the New York office of the American Street and Interurban Railway Association, and we feel greatly indebted to its secretary for the interest he has shown in these matters. The data sheets and circular letters have been sent in duplicate to over 800 street and interurban railway companies to be filled out and returned with accompanying drawings and sketches. A considerable number of the data sheets on brake-shoes and flange and tread of wheels has been filled out and returned with sketches and suggestions as to proposed standards. The replies indicate that the managers and engineers of the railway companies realize the importance of the work, and that they have given considerable time and thought to the preparation of their answers to the various questions asked. A number of the data sheets relating to rails and journals and journal boxes, together with accompanying drawings and sketches, has also been received at the secretary's office; although it was not practicable for the committee to issue these data sheets before the middle of September.

The information obtained by means of these various data sheets must be carefully collated and summarized, in order to make it practicable for the committee to make proper use of the same. The drawings and sketches must also be studied, and new ones made up which embody the recommendations of the various companies. This means a large amount of detail work on the subjects now under investigation, which must necessarily devolve upon your standardization committee during the coming years. It therefore does not appear to the committee to be advisable for the association to undertake much new work in the line of standardization of equipment at the present time. However, it would be well to begin the investigation of the standardization of some few additional parts of electric railway equipment in order that the work of the committee may be continuous and uninterrupted. It is expected that the standardization of motor parts will be added to the work of the standardization committee for the coming year.

It is our desire to emphasize the necessity of standardization of equipment. Some street and interurban railways have already made sincere efforts to standardize certain parts of their equipment, parts that would be standard so far as these particular companies are concerned, but no joint effort has heretofore been made in this direction. Owing to extensions and consolidations which are constantly taking place in the various electric railway systems, an interchange of cars and equipment will ultimately become necessary, and it is the hope of the committee that the companies which have not already returned the data sheets will give them prompt and careful consideration.

In its report the committee appended copies of the various circular letters and data sheets which were sent out to the electric railway companies of the country during the past year.

REPORT OF COMMITTEE ON CONTROL APPARATUS

PRESENTED BY J. S. DOYLE

The question of multiple-unit control was exhaustively treated at our last convention in a paper presented by Hugh Hazelton, and it is gratifying to note that the use of multiple-unit control apparatus for heavy service has increased during the year so that its use for new equipments has become the rule rather than the exception.

Both the General Electric and Westinghouse companies have continued to develop this type of apparatus in the respect of reducing the weight and number of parts, and also increasing the pressure between the contact points of the switches. This latter development may be said to be the greatest improvement accomplished.

The committee noted at the last convention that the greatest amount of interest was shown in the standard street car control problem, and Messrs. Olds and Adams made the statement that they had followed suggestions of previous conventions and were then installing equipments with contactors located beneath the car, which was for the purpose of obviating the platform cylindrical control failures that have been so generally complained of in the past. This particular type of control has been in service some time now, and the committee expects an interesting report from these gentlemen.

A number of the members of this association were very strongly of the opinion that the multiple-unit type of control of standard street car service could not be reduced sufficiently in size to permit of installation in the limited space afforded by the ordinary car, but the committee is pleased to state that both manufacturing companies have been working with this end in view, and have succeeded in reducing this control equipment so that it can now be installed on the standard street car.

The great efficiency of the larger types of multiple-unit control also obtains in the smaller sizes, so that this apparatus should be a great improvement over the present practice.

Progress has been made by each of the manufacturing companies on control apparatus for heavy railway locomotive work. Single switches having a capacity of from 1000 to 2000 amperes have been developed, but inasmuch as these locomotives have not as yet been placed in regular service this subject shall have to be deferred until the next meeting, at which time the control committee hope to have a more extensive subject to work upon.

QUESTION BOX OF THE ENGINEERING ASSOCIATION

Q. 1. Where feeder wires are partly underground and partly overhead (same circuit) have you experienced much trouble from lightning injuring underground cables, and how do you arrange lightning arrests?

Place lightning arresters at each end of the cable, that is, one at

the station and one at terminal end; then install lightning arresters on the line every 500 ft.

Q. 2. What do you find to be the most reliable lightning protection for stations on 550-volt d. c. service, also on 11,000-volt transmission lines?

(1) For 550-volt d. c. stations a lightning arrester at the station on each feeder, and one on each machine gives good protection, provided the line is also properly taken care of with arresters spaced from 500 to 1000 ft. apart.

(2) A water resistance thrown in at the station whenever a storm is approaching is a good protection.

Q. 3. What advantage has the six-bolt splice-bar over the four-bolt?

(1) On the modern and approved type of rails now generally in use with the improved types of joints on the market, we do not think that a six-bolt splice-bar or joint has any advantages whatever.

(2) Fifty per cent more strength to resist strain in every direction.

Q. 4. What is the best spacing for interurban trolley poles?

(a) This depends somewhat on the type of overhead to be constructed, for the ordinary d. c. trolley lines with No. "OO" or No. "OOO" wire from 100 to 110 ft., seems to give entire satisfaction.

(b) Poles should be spaced on interurban lines 100 ft. apart on straight lines and 50 ft. on curves.

Q. 5. What are the advantages and disadvantages of bracket arm, or center-pole construction and suspension, as against side-pole construction on interurban lines

Bracket line is cheaper construction, if properly built, and poles more perpendicularly for carrying transmission lines. Side construction is not so rigid.

Q. 6. What do you consider is the proper height for trolley wire above the rail?

(1) I consider the proper height for trolley wire above the rail at 20 ft. or 22 ft. maximum, and not less than 16 ft. under any condition.

(2) Eighteen feet on straight line, increased to the height required by law over railway crossings.

(3) An average height of 19 ft. 6 ins. gives good results.

Q. 7. On lines where speeds do not exceed 25 m. p. h., should the trolley wire be kept as tight as it can be with safety, or should it be somewhat slack? Which condition will give the wire the longest lift?

(1) Do not think it advisable to keep the trolley wire too tight under any conditions.

(2) On lines where speed does not exceed 25 m. p. h. the trolley wire should be kept as tight as safety will permit. Tight wire gives longest life.

Q. 8. What is the proper tension for trolley poles with 4-in., 5-in. and 6-in. trolley wheels, giving length of pole?

(1) 25 to 40 lbs. with 14-ft. poles.

(2) 16 to 19 lbs. with 4-in. wheel and 13-ft. pole, including wheel; 19 to 22 lbs. with 5-in. wheel and 13-ft. pole, including wheel; 22 to 25 lbs. with 6-in. wheel and 13-ft. pole, including wheel.

(3) The tension of trolley poles should be about 25 lbs. against the wire with poles 12 ft. long on interurban cars; for city cars, 18 lbs. against the wire, with poles 13 ft. 6 ins. long is sufficient.

Q. 9. What diameter and weight of trolley wheels are best for use on cars in strictly city service?

(1) 5-in. to 6-in., weight from 3 to 4½ lbs.

(2) A 5-in. wheel weighing about 2¾ lbs.

Q. 10. What diameter and weight of trolley wheels are best for use in interurban service?

Six-inch, weight about 4½ lbs.
For speeds up to 35 m. p. h. maximum, a 5-in. wheel 2¾ lbs.
For speeds above 35 m. p. h., a 6-in. wheel 3¾ lbs.

Q. 11. What mileage is obtained from trolley-wheel bushings?

(Combined answers for 11 and 12).

(1) Average about 4000 miles on city for four-motor equipments, with ½-in. bushing, 1 9/16 ins. in length.

Q. 12. State the diameter and length of trolley-wheel bushing used?

(2) Average about 4500 miles on 4-in. wheel for ½-in. x 1½-in. bushing. Average for 5-in. wheel with 5/8-in. x 1½-in. bushing, 6500 miles.

Q. 13. What is the maximum grade on any interurban line?

The maximum grades on our interurban lines outside the city are 3 per cent; inside the city 6 per cent.

Q. 14. What weight of rail has been found best adapted for and most economical on interurban lines?

Q. 15. Is an 80-lb. A. S. C. E. section of T-rail sufficiently heavy for present and prospective interurban traffic.

(Combined answer for 14 and 15).

(1) This is in course of evolution. We have adopted an 80-lb. A. S. C. E section of T-rail, and believe it the best for our conditions.

(2) Depends entirely on rolling stock. For most modern cars 100-lb. rail is none too heavy.

(3) Eighty-pound A. S. C. E. section is all right for cars weighing up to 25 tons.

(4) In this vicinity 80-lb. A. S. C. E. section of T-rail has been found most satisfactory for interurban lines.

(5) Eighty-pound A. S. C. E. section of T-rail is considered sufficiently heavy for present prospective interurban traffic.

Q. 16. What is the cause of corrugated rail on street railway tracks? What measures can be taken for its prevention? What remedy can be applied to rails which are already corrugated?

A comprehensive answer to any of the three parts of this question is impossible, and this is a subject on which a special committee might well labor for some time to come.

Q. 17. Is there any paint or other preparation to be applied to ties or poles to prolong their life? What does it cost?

Mr. Alderman's paper on "Ties, Poles and Posts" will probably contain a thorough answer to this question.

Q. 18. What is the best type of paving block to use against T-rail in paved city streets?

(1) We use a square granite block from 8 to 12 ins. in length, and find that if care is used in laying such blocks and the abutting pavement no trouble is experienced. In brick pavement the plain brick is all that is required. A grooved block or brick is not necessary unless the ball of the rail is unusually deep.

(2) Brick molded to proper shape where traffic is not too heavy. On streets where traffic is heavy and likely to follow the rails no pavement will stand. Other rail sections should be used.

Q. 19. What is the most approved method of placing and surfacing steel tie construction and of excavating for concrete stringer and floor? Give detail dimensions?

Q. 20. What is the most approved method of concreting for steel tie construction and brick paving? Give details of concrete stringers and floors.

Q. 21. Give spacing of ties and tie-rods with reference to each other and the rail joints?

Q. 22. What is a good rule of thumb for proper curve elevation on an interurban railway?

Q. 23. Would the use of metal tie-plates tend to lessen the electrolysis betwen rail-base and spike-head?

Where this electrolysis exists I believe a tie-plate would only serve to accentuate it; proper bonding is the best remedy.

Q. 24. How many miles of interurban track can or should be maintained per trackmen employed?

The general practice on interurban roads has been to maintain too few men for this work. The writer's opinion is that one man to 2½ miles is nearly right.

Q. 25. What is the most advantageous width for rights of way for interurban lines?

(1) Unless the country traversed is unusually flat and level, 100 ft. is advisable, as it provides for all ordinary contingencies except particularly deep cuts or fills.

(2) A right of way 60 ft. wide is sufficient for most conditions.

(3) Interurban lines should have right of way 50 ft. wide.

Q. 26. Which do you find cheaper in eliminating weeds from private right of way, chemicals or manual labor? If chemicals, what formula and method of applying can be used?

(1) Believe that a process of burning with a gasoline burner can be perfected which would be most efficacious.

(2) The use of chemicals is much cheaper than manual labor. There are several arsenic compounds upon the market for this purpose. They may be applied from a sprinkling car made of wood by using brass piping and valves.

Q. 27. What per cent depreciation is there in the soldered type rail bond

after a period of five years on exposed or unexposed track? Do you consider soldered bonds equal to compressed bonds?

Q. 28. What is the cost per cubic foot for the constructioin of a modern car house? State the type of construction and general features.

(1) An extensive car house and shop combined, built with brick walls, steel truss, monitor roof, which is covered with slate, not fireproof and without sprinklers, cost 5.8 cents per cubic foot.

(2) A car house built of reinforced concrete throughout, having roof supported on columns, all of reinforced concrete, equipped with sprinkler system, including aisle sprinklers, metal sash and wire glass, making a fireproof building, cost 7 cents per cubic foot.

Q. 29. In a car house, what is the best distance between track centers for a system of between 300 miles and 400 miles of track, and operating from 500 to 800 cars?

(1) Track centers 10 ft. 6 ins. can be used to advantage where the cars do not exceed 8 ft. 2 ins. over posts. Increase this if you can afford it.

(2) Car houses should be built with tracks 15 ft. center.

Q. 30. What is the most practical design for pits to be used in operating car houses?

(1) In a car house where inspection of cars is a large item, the pits arranged with depressed aisles are desirable. By using a deep girder rail the same may be supported upon I-beams or columns every 10 ft. The aisle should be depressed 18 ins. below the head of the rail.

(2) Sidewalks to be formed of concrete, using wide base rails anchored to walks or plates riveted to base of rails used to give bearing. Pits to be connected in pairs by passage ways. Drops for wheels should be placed on one or more pits.

(3) The most practical design for pits in an operating car house are those where the tracks set on concrete pillars, leaving the entire space underneath the tracks open. This is an economical construction, and gives plenty of space for ventilation between different pits, and by setting the girder rails in the concrete pedestals a rigid track construction is obtained. Between the tracks can be floored with ½-in, openings between the planks. This will be found a considerable better construction than the usual mode of making a continuous pit for each track.

Q. 31. What proportion of the total trackage in the house should be devoted to pits?

(1) About 20 per cent of the trackage should have pits.

(2) I would consider that the smaller car houses should have pits under all the tracks, and for larger houses 50 per cent of the tracks should be pits, arranged so that the cars pull over the pit end of the tracks upon coming into the house.

Q. 32. What is the mileage obtained upon armature bearings for the various types of motors?

(1) With oil lubrication packed with wool waste about 50,000 miles; oil lubrication with wick-feed oil cups about 25,000 miles.

(2) Average mileage of armature bearings for Westinghouse 49 motors, 26,926 miles. Average mileage of armature bearings for Westinghouse 56 motors, 30,381 miles. Average mileage of armature bearings for Westinghouse 3 motors, 19,075 miles. Average mileage of armature bearings for Westinghouse 12A motors, 23,394 miles. Average mileage of armature bearings for G. E. 800 motors, 17,998 miles. Average mileage of armature bearings for G. E. 1000 motors, 27,321 miles.

Q. 33. In case babbitt is used, what is the formula of same?

(1) In making babbitt metal for armature bearings for various types of motors the following formula will be found to be quite satisfactory: Tin, 82 per cent; antimony, 10 per cent; copper, 8 per cent.

The copper should be added after the other mixture is thoroughly melted. As a simple shop test for testing babbitt metals of various makes to insure uniformity in the metal and also to determine approximately the material of which it is composed, a simple drop test will be found to be of advantage. This should be arranged with a drop of a known weight falling a certain distance, and a record kept of the number of blows required to break a bar of the metal of various compositions.

(2) Babbitt formula: Tin. 64.5 per cent; antimony, 9.5 per cent; copper, 2.0 per cent; lead, 24.0 per cent.

Q. 34. What is the average of oil lubricated motor bearings on interurban cars equipped with four 50-hp, four 75-hp or four 100-hp motors?

With four 65-hp motors we obtain an average of 60,000 miles.

Q. 35. Have any oil cups been found to be entirely satisfactory to replace cups on motors not designed for oil?

(1) While it cannot be said that oil cups have been found to be entirely satisfactory to replace cups in motors not designed for oil cups, oil cups are a very great improvement over the original mode of lubrication, and, if given proper attention (as required), periodical cleanings, a very much more satisfactory result will be obtained. A lubrication by wool waste packing and oil placed in the oil cups not designed for oil will be found to be considerably more satisfactory than the lubrication originally designed for these motors.

(2) Yes.

Q. 36. What is the best method of grinding a rotary engine's air valve?

We arranged an old hand drill to accomplish this work, this drill had an automatic feed wheel at the top, operated by a lever and dog, which engaged in the teeth on the feed wheel, the lever being operated by an eccentric on the driving shaft.

The main spindle of the drill was extended through to where the feed wheel was, and in place of the feed wheel an arrangement was made to hold the valve with its face up, the valve seat was then placed on top of the valve and attached by springs to the lever operated by the eccentric.

The operation is as follows: The machine is driven slowly by a small belt and pulley, which was substituted for the hand power arrangement; as the main spindle revolves the valve is rotated, and the valve seat, resting by its own weight upon it, is moved from side to side by the motion of the arm; by the application of powdered emery and oil the grinding is carried on.

Q. 37. What is the life and cost (per 1000 wheel-miles) of cast-iron wheels, including grinding?

(1) On four-motor equipments, city service cast-iron wheels average 40,000 miles.

(2) The life of cast-iron wheels in city service should be about 40,000 miles, and the cost per 1000 miles about 70 cents.

Q. 38. What is the life and cost (per 1000 wheel-miles) of rolled steel wheels?

(1) The life of rolled steel wheels should be at least 120,000 miles.

Q. 39. What is the life and cost (per 1000 wheel-miles) of steel-tired wheels, cost based on cost of tires only? State average number of turnings, cost of same and mileage for each turning?

Q. 40. What are the advantages and disadvantages claimed for the rolled, forged and steel-tired wheels?

Q. 41. What average mileage is obtained for each in city and suburban service for 1-16-in. reduction in diameter?

Q. 42. What kind of center for steel-tired wheels are best for use under city cars?

Q. 43. Do hard brake-shoes wear out the tread of the wheel faster than a softer shoe on a surface road?

No.

Q. 44. What is the best design of interurban brake hangers and hanging to minimize or overcome the chattering or "hogging" of the brakes as the car is brought to a stop?

(1) There are several improved hangers on the market designed specially to meet this condition.

(2) A slide brake rigging, having a wearing shoe shrunk on the ends of the brake beams, and wear plates, which can be shimed in the brake slide castings, will meet this condition satisfactorily.

Q. 45. What is the best way of refilling a controller cylinder? What material is used?

Q. 46. When the controller, circuit breaker and motors are in good condition, what causes a controller to blow up, and what can be done to prevent it?

Q. 47. Would it be best on an interurban car to have each motor separately fused in addition to the main circuit breraker?

Yes, the individual fuse on each motor makes the best arrangement in addition to the circuit breaker, particularly with four-motor equipments.

Q. 48. What special provisions should be made when building cars for limited service, to accommodate the commercial traveler and his baggage?

It would appear that the only special provisions which should be made when building cars for limited service to accommodate the commercial traveler and his baggage would be to build the car sufficiently long to permit three compartments, *i. e.*, the baggage, smoker and coach departments. This can be done very nicely with a car 60 ft. long, which will leave a baggage compartment, which will also accommodate the motorman and the necessary apparatus. Cars in service in this locality arranged in this manner are giving very good satisfaction.

Q. 49. Is there any compound which can be recommended for use in

cleaning cars, and if so, what kind and in what quantity should it be used?

A cleaning compound composed of linseed oil soap, of which there are a number of makes on the market, has been found to be quite satisfactory for cleaning cars at the car house, 8 lbs. will be found sufficient to clean a double-truck car and 10 lbs. to thoroughly clean an interurban car. This does not refer to cleaning a car preparatory to revarnishing.

Q. 50. What plan would you recommend as best adapted for repair shop and car house, operating about forty-five suburban cars, where the ground is unlimited?

Where sufficient ground is obtainable a double-end barn and repair shop will be found to be a decided advantage, where the cars can pull through the repair shop end and undergo the necessary inspection and repairs, and pass on into the barn and out at the other end into service. This will be found a considerable saving in time and labor in handling the cars with the least possible expense.

FIG. 1.—COMBINATION REVERSE WRENCH

Q. 51. Which is the more practical, a transfer table or double-end shop?

Where sufficient ground is available a double-end shop is a decided advantage over using a transfer table.

Q. 52. What is the practical result, from a car-body standpoint, of platforms 6 ft. or 7 ft. long?

Q. 53. What are the average weights of cars? Give lengths over corner-posts and over bumpers.

FIG. 3.—MOTORMAN'S TOOL BOX, CLOSED

(1) 40,000 lbs., including trucks and electrical equipment. Lengths over corner posts 29 ft., over bumpers 41 ft.

(2) Semi-convertible car, 30 ft. 8 ins. over corner posts and 42 ft. over bumpers; four-motor equipments, weight 45,000 lbs.

Closed car, 28 ft. over corner posts, 40 ft. over bumpers; two motors, double truck, weight 29,230 lbs.

Convertible car, 30 ft. 5 ins. over corner posts, 41 ft. over bumpers; two motors, double trucks, weight 31,700 lbs.

Closed car, 23 ft. over corner posts, 34 ft. over bumpers; two motors, single truck, weight 22,286 lbs.

Open cars, twelve-bench, 31 ft. 9 ins. over corner posts, 40 ft. over bumpers; two motors, double trucks, weight 30,744 lbs.

Q. 54. How many roads have discontinued the use of sand cars, in order to decrease the number of flat wheels, and what has their experience been? Has it not resulted in an increase in accidents?

(1) Roads using steel wheels can dispense with sand cars, except when rail is extremely bad.

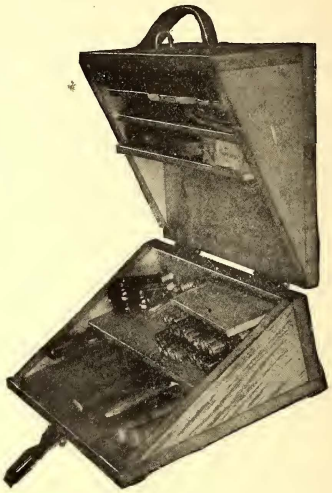


FIG. 2.—MOTORMAN'S TOOL BOX, OPEN

(2) We do not use sand cars, but have four sand-boxes on each car. The question of skid flats does not alone depend upon the use of sand cars, brake pressure, and the method of hanging the brake affect this problem as well.

Q. 55. How can the mechanical department best assist the manager to build up business of evening riding on an interurban railway?

Having the cars neat and clean and so designed that it will be a pleasure to ride on them, at the same time be sure that your electrical equipment is in first-class condition.

KINKS

1. Combination reverse wrench which can be used on a road where GE-K type controllers are used, and also the multiple-unit type M, the right-hand end operating K-6, K-10 and K-11, and the left-hand end C-6, C-8, C-28, etc. This wrench is shown in Fig. 1.

2. Tool box for motormen. Its outside dimensions are 13 ins x 16½ ins x 6¾ ins. Fig. 2 shows the box open, while Fig. 3 shows the box closed.

It contains the following: One red fusee, one green fusee, one 8-in. flat mill file, one 10-in. monkey wrench, four two-ply copper ribbon fuses, 800 amp.; two four-ply copper ribbon fuses, 400 amp.; one 14-oz. machinist hammer, four ⅜-in. x 6-in. headlight carbons, 1 pair 8-in. side-cutting lineman's pliers, one combination reverse wrench, one 9-in. screw driver, one 8-in. flat cold chisel, ¾-in. octagon, four 25-amp. cartridge fuses, three 25-amp. cartridge fuses, four 10-amp. cartridge fuses, four 4-amp. cartridge fuses, three 3-amp. cartridge fuses, one 16-cp. incandescent white globe, one 1-amp. fuse wire, one 16-cp. incandescent ruby globe, two 150-amp. cartridge fuses, one roll acme tape, one switch rubber, six railway torpedoes, one red flag, one trolley rope, six No. 6 rubber-covered cable, one pair rubber gloves, one padlock. Weight of box fully equipped 28 lbs.

PROCEEDINGS OF THE AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION AT THE COLUMBUS CONVENTION

MONDAY MORNING SESSION

The fourth annual meeting of the American Street and Interurban Railway Engineering Association was held at the Fair Grounds, Columbus, Ohio, Oct. 15-17, 1906.

President H. H. Adams, of Baltimore, Md., called the first session to order on Monday morning at 11:15 o'clock, and introduced E. C. Spring, president of the Central Electric Railway Association, who made the address of welcome, in part as follows:

MR. SPRING'S ADDRESS

Mr. President and Gentlemen: It seems very pertinent and is also very gratifying to me that the first words of welcome to be given to this great convention this morning should come from those who are co-laborers in the same field; in other words, a welcome of one brother to another. We of the Central States feel highly honored to think that the American association has arranged to hold its convention in the State of Ohio, and particularly in the city of Columbus. We feel particularly honored and gratified that you are with us. This association has a great many allied associations, and associations that have been offsprings from it. The Central Electric Railway Association, comprising as it does all the Middle Western States, representing more particularly the interurban field, is the child of the parent organization, and as president of that association, it gives me great pleasure to welcome you to the State of Ohio, and to its capital city, Columbus. We feel that by your meeting here in this city, the inspiration which will permeate the electric field after you are gone will be great, and that we will receive a stimulus to renewed activity which will produce great results of benefit to the industry which we represent, and we believe that you will take with you a more comprehensive view of the interurban field than you have had before.

The interurban field in itself occupies a position quite distinct, being different from the municipal operation of street railways and suburban operation, and I trust that every delegate to this convention will make it a point to traverse the States of Ohio and Indiana that he may better see for himself what is being done in this field, and all the managers of the various roads connected with the interurban field stand ready to give you any hospitality, any courtesy, that you may desire.

Your Engineering Association occupies in my mind one of the most important positions to-day in the electric railway world, inasmuch as the gigantic task of standardizing equipment has been placed at your door and the entire electric world is watching the results which will be the outcome of your deliberations, and until that time comes, when we can have a standardization of equipment, from the rail to the wire, we can not hope to gain the results in operation which we will do at that time. (Applause.)

Mr. President, I again extend to you and the members of the Engineering Association a hearty, royal welcome to our commonwealth and to this capital city. (Applause.)

President Adams thanked Mr. Spring in the name of the association for the cordial address, and hoped that the association members would avail themselves of the opportunity set forth to study this interurban field. He then introduced J. H. McGraw, president of the Manufacturers' Association, who spoke as follows:

MR. McGRAW'S ADDRESS

Mr. President and Gentlemen: I am sure it is not necessary for me to go to the platform to say anything I may have in mind, because the Manufacturers' Association has not really got under way yet in so far as the oratorical part of the convention is concerned. You know the manufacturers are men of deeds and action and not men of speech or poetry, like our friend, Mr. Spring. (Applause and laughter.) But I can say, Mr. President and Gentlemen, on behalf of the Manufacturers' Association, that we have been at work on our part of this convention since last March, and you see the result. You see here six buildings, well equipped, well laid out, and the exhibits all in readiness. The last circular said that there must not be the sound of a hammer or a saw after 6 o'clock on Saturday night. That condition we did not quite fulfil, but I am sure, Mr. President, you hear no noise here at the present time.

We are the allied association of the American Street and Interurban Railway Association. We are here to help in every possible way, and we believe that when you go away from this convention you will say that never before have the manufacturers placed in position such an ideal exhibit, so comprehensive and so well done as is the present exhibit here in the city of Columbus. And I might say in passing that never before have we had so good a lay-out, so many buildings so well arranged as we have in this city of Columbus. The people of Columbus in every way have been most hospitable and kind and have facilitated our work in every possible manner, so that I am sure that none of us, the parent association or any of the affiliated associations, will have any regret whatever in coming to the city of Columbus for this convention. As the president of the Central association has so well said, this to-day is the center of the great interurban field, and the interurban railway as a railway has just begun. The possibilities in what is in sight during the next five years are marvelous. No other word will cover it.

Mr. President, we believe that the Engineering Association has a great work; we believe that the way the parent and the affiliated associations have been put together is on right lines, that the present plan is broad-gaged and comprehensive; we believe that the parent organization and its affiliated associations are to become the greatest technical and scientific organizations that this country affords in any field of activity, and the Manufacturers' Association, as allied with you, will do its full part in every particular, not only in the development of apparatus, but in these gatherings in a social way, and from the point of view of exhibits, to your entire satisfaction. I thank you. (Applause).

President Adams said the members of the Engineering Association appreciated the remarks of Mr. McGraw in reference to the manufacturers' point of view, so far as they as engineers were concerned, and the engineers were ready to meet the manufacturers more than half way in their efforts to solve the problems that are constantly arising.

The minutes of the last meeting were approved as published.

President Adams then introduced John I. Beggs, of Milwaukee, first vice-president of the American Association, who complimented the engineers upon the splendid work that had been accomplished by the Engineering Association. Mr. Beggs expressed his pleasure at having the opportunity of meeting with the Engineering Association, and expressed the hope that he might be able to attend many of its sessions.

President Adams then read an address, as follows:

PRESIDENT ADAMS' ADDRESS

Gentlemen:—The executive committee of the American Street and Interurban Railway Association decided this year to give special attention to the interurban field at the annual meeting, and, in determining upon the location for the convention, Ohio was selected as the State having the largest interurban mileage in the United States and this beautiful city of Columbus, the capital, was decided upon as one of the greatest interurban centers in the State, if not in the country. The wisdom of this selection is beyond question and the cordial welcome which we have received speaks well for the success of this convention.

This is the fourth annual convention of this association, the past three having been held under the name of the "American Railway Mechanical and Electrical Association." During the last year we have passed through the stage of reorganization and we stand to-day upon a much firmer platform than ever before in the history of the association. We are now connected in a definite manner with the main body, the American Street and Interurban Railway Association, and are linked closely with the other allied associations, namely, the Accountants' and the Claim Agents'. We have a representative upon the executive committee of the American association (or the main body) and the benefit of this is that our association has a direct voice in the general work of that body, and, especially, as it relates to the allied asso-

ciations, our financial condition has been decidedly benefited. The sum of $2000 was appropriated for the carrying on of this year's work and appropriations are to be made each year from the main treasury, as the requirements of the association demand.

At the convention held in Philadelphia the question of reorganization was placed in the hands of your executive committee, with power to act, and, in accordance with the resolutions passed at that time, this committee prepared a constitution and by-laws, which were finally accepted by the executive committee of the American association. The constitution and by-laws were arranged to conform in as many particulars as possible with the constitution and by-laws of the Accountants' and Claim Agents' Association, as it seemed desirable to make this arrangement in order to have some uniformity between them. The individuality of our association has been fully maintained; we have our officers and a secretary and treasurer, who is separate and distinct from the secretary of the American association.

One of the most difficult features with which your committee had to contend in this reorganization was the question of taking care of the individual members, who were termed "active members" in the old association. This question was finally determined by having the active members of the old association become associate members of the American Street and Interurban Railway Association and ally themselves with this, the "engineering" branch. This is a fortunate method of taking care of the individuals, as it gives them all the advantages of membership in the engineering association as well as membership in the American association.

At this point I desire to extend my thanks to the members of the executive committee of this association for their co-operation and able assistance in this matter. It required a great amount of work to arrange and re-arrange a constitution and by-laws, which would conform to the plan as outlined last year by the American association, and it was through the valuable assistance of the various members of this committee that we were able to present an acceptable constitution and by-laws.

While speaking on this question of reorganization, I desire to thank W. Caryl Ely, the president of the American association, and the various gentlemen allied with him as representing that body, as well as the presidents of the other allied associations, the members of the executive committee for the kind consideration which they have given our association in this matter, and I can assure you, gentlemen, that, with this kindly feeling existing, the success of our association under the reorganization is assured.

Your committee, in considering the work for this year's convention, was confronted with the fact that there is a large amount of work to be accomplished by this association, and we had to confine ourselves to subjects which we considered of greatest importance for presentation at this meeting. The subjects selected will speak for themselves. Continuous work has been accomplished through standing committees, either carried over from previous years or recently appointed, such as the committee on standardization. This is a desirable method of carrying on the work, as the changes which are taking place in the railway world require constant study in order to keep abreast of the times. Although it is not my purpose, at this time, to outline definitely the work for the future, there is one point which appeals strongly to us all as being worthy of consideration and that is the question of construction of our buildings, particularly from the fire standpoint. Within the past few years we have had several examples of what may be done in the line of fireproofing building in connection with conflagrations, and I speak from experience when I say that it is possible to build in such a way as to withstand the attacks of a conflagration. At present each of us is working out his plans as they are needed, and, if some combined steps could be taken in this direction it would be of great benefit for the future. This is a matter that the insurance committee is to report upon, but the details of construction belong to our engineering association. Take, for example, the new schemes of fire protection in car houses by the use of aisle sprinklers. Up to date, there have been a number of car houses equipped with these systems. Are we sure that the present method of installation is the best, or is it possible to improve it? This is a subject into which the association can well afford to look.

The standardization committee, which was appointed during the past year, has been doing a vast amount of work. It was not the intention of this committee to solve this vast problem in one jump, but to attack the same in a systematic manner in order to lay the foundation or basis on which to work, and, although the committee has no definite conclusions to submit for the approval of the association at this meeting, the work which they have laid out has been very thorough, and an examination of the data sheets that were sent out by the committee will show the details they have undertaken.

The committee has met with liberal response from the various roads, and it is hoped, in the future, the response will be even greater. At the present time it has under consideration brake-shoes, wheel treads, flanges, journals, journal boxes and rail sections. In the work of standardization your committee has endeavored, as far as possible, to confer with the manufacturers interested in the various parts and it has met with very encouraging responses from every direction. It is the hope of the committee that among the results to be accomplished in the future will be the standardization of certain parts of the electrical equipments, especially such parts as the commutators, brush holders and brushes, gears pinions and axle bearings upon motors of the same horse-power. This result can only be accomplished by the full co-operation of the various electrical companies interested, but I feel sure that when the committee is ready to take up this question, the companies will stand ready to assist it in every possible way.

Before leaving this subject, however, I want to extend my thanks to the committee and particularly to its chairman, Mr. H. Wallerstedt, for the able and earnest work that has been done up to the present time, and, although the work is in its infancy, I am confident of its success.

During the month of March, 1906, one of the members of the executive committee, who was elected at the Philadelphia convention, W. Boardman Reed, resigned his position on that committee, owing to the fact that he had left the services of the New York City Railway Company to enter into private business. It was with great regret that Mr. Reed's resignation had to be accepted, as he had been of the greatest assistance as a member of the committee. W. T. Dougan, of the New York City Railway Company, was appointed in his place by the executive committee in accordance with the by-laws.

Our association has for its object the bringing together of those engaged in street and interurban railway engineering for the interchange of ideas; to acquire and distribute information and to promote uniformity of practice. We bring together under the head of "Engineering," construction and operating engineers of all branches in railway work and upon us as engineers rests a great duty. We do not necessarily come in direct contact with the public, rather occupying the position of the "men behind the guns," but the engineer's duty to the traveling public is of the greatest importance. Upon him rests the question of reliability of service. If there is trouble in the power house, in the overhead lines and cables, or on the cars, it is "up to the engineer." It is his duty to reduce to a minimum the interruptions due to defects. Nothing is more aggravating to the traveling public than interruptions to the service. Explanations are not wanted, but continuity of service. In the period in which we are operating we are facing questions of great moment as affecting the relations of our companies to the traveling public, and may it be the aim of this association so to direct its work, that it will be of the greatest assistance in mastering these questions; and may we as engineers so fulfil our duties to our respective companies, and through them to the traveling public, as to give that reliable service which is desired and thus render the most effective service possible in connection with these problems.

In conclusion, let me say that the hasty glance we have had this morning of the exhibits, which have been prepared by the Manufacturers' Association, is certainly an indication that we can spend considerable time in studying them to our profit. Without doubt this is the finest lot of exhibits over gotten together for one of our conventions and the Manufacturers' Association has our congratulations.

I wish to extend my thanks and appreciation to the executive committee and other members of the association for their hearty co-operation during the past year. The assistance given has been of great value to the association and to me in carrying on the work.

President Adams then invited W. B. Brockway, president of the Accountants' Association, to address the meeting.

Mr. Brockway said it was not his purpose to make any remarks when he entered the room, but had rather hoped to take the position of the signs which are put at crossings. He wanted to "stop, look and listen," rather than talk. He was glad of this opportunity, however, to express the interest and sympathy of the accountants in the work the engineers are doing. The interest between the two associations is very natural, because each accountant in his own company is very

much interested in the work of the engineering department. The work of the accountants and engineers is very closely allied in the practical operation of the railroads, and it seems very natural that the associations themselves should be interested in each other's work. He extended a cordial invitation to the delegates of the Engineering Associaton to attend the meetings of the accountants.

Secretary Mower then read the minutes of the various meetings of the executive committee which had been held during the fiscal year. These minutes embodied the record of the work transacted by the committee in the management of the association and the arrangements made for the annual meeting. These minutes were approved as read.

The report of the secretary and treasurer was then read and approved. The treasurer's report showed receipts of $2,272.63; expenses, $2,109.97; balance, $162.66.

President Adams stated in this connection that the financial matters of the association are now on a different basis, as the American association supplies the funds needed to carry on the work. He said the American association recognizes that the Engineering branch is doing its work in the manner in which it should be done, and is willing to appropriate the necessary funds with which to do it. This year it has been a matter of running a little close in the expenses, because it was rather doubtful just what the receipts of the American association would be, but the report which the treasurer of the main association would submit shows that the reorganization is on a substantial basis. This year the Engineering Association had done comparatively little committee work, but the president believed that when it desired to do more committee work the expenses of the committee would be taken carc of by the main association.

The president then appointed the following committee on resolutions: G. J. Smith, of Kansas City; Charles Hewitt, of Philadelphia, and E. W. Olds, of Milwaukee.

Secretary Mower then read a letter from S. N. Rhoades, president of the Claim Agents' Association, inviting the members of the Engineering Association to be present at the meeting of the Claim Agents' Association; also a letter from W. O. Thompson, of the Ohio State University, extending an invitation to the delegates to visit the buildings of the University and to inspect the equipment of the various departments and the work that is being done; also a letter from R. A. Read, representing the Central Union Telephone Company and the American Telephone & Telegraph Company, extending the courtesy of the telephone lines of these companies, the long-distance service to be used after 6 o'clock at night. The secretary also read a letter from H. A. Wallerstedt, chairman of the standardization committee, regreting his inability to be present at the meeting.

The meeting then adjourned for luncheon.

MONDAY AFTERNOON SESSION

President Adams called the meeting to order at 2:10 o'clock and invited President Ely to address the members in regard to the reorganized association.

Mr. Ely, in referring to the association, said that its success was now practically assured. Nevertheless there was considerable yet to be done, especially in demonstrating the advantages of the new body. The Engineering Association is one of the most important branches of this organization, and one that appeals in the strongest possible way to some of the larger members of the parent association. He favored such an association, unless it should take a form injurious to the older organization; but if it took that form, he was unalterably opposed to it. Mr. Ely said that he referred to the matter because some of the delegates represented those great companies, and he thought that notice ought to be served on them in a manly and firm way, that there is room for both, and that there might be such an organization while the benefits of the present organization remained as great or even greater than if the other did not exist. But, whether that shall come or whether it shall not come, Mr. Ely said he looked to the Engineering Association, and its members as individuals, to be mindful of the great benefits which come from these associations and this group of associations. He did not think that a man from Missouri would have to be shown anything after he should spend a week at this convention. The trouble is that it is difficult to get here those who are at the heads of the larger companies. They are busy men, their minds are engrossed with problems that are of themselves, and apart from the problems that their subordinate officers or heads of departments entertain, and it is difficult to get them to come here, and difficult to get the results of the work that has been done brought to their attention. Each member can be very instrumental in carrying and imparting information to the managing officers and the executive officers concerning the value of the work. Mr. Ely concluded by complimenting the association on its efforts.

President Adams then called upon Mr. Doyle to present the report of the committee on control apparatus. This report is published on page 719.

President Adams then declared the report open for discussion.

G. J. Smith, of Kansas City, said that the Metropolitan Street Railway, of Kansas City, has had in service for three months thirty cars, 30 ft. 7 ins. over corner posts, with the type-M multiple-unit control. These cars operate as single units, and from present indications the results will be so far superior to the platform controller that the management to-day is considering installing the type-M control on 120 of the same type of equipment and doing away with the platform control. This control is adopted to get rid of panics created by troubles in controllers operated on the platforms. In Kansas City the grades are such that at times the motors take in 800 amps., at 575 volts. The average amperes on the Troost Avenue division are 153, on ten seconds reading. That current is too heavy to handle with a platform controller.

E. W. Olds, of Milwaukee, said that his company put into service last year fifty cars with the contactor in series. In throwing off the current the contactor opens a little ahead of the controller. The cars first equipped with the controllers caused a little trouble on account of mechanical defects in the construction of the control circuit breaker. That was remedied by the General Electric Company, and since that time they have been working satisfactorily. The company has yet to have any blow-out on the front platform of these fifty cars. Should a short-circuit occur in operation, as will occur occasionally, on any platform controller, the motorman can at once throw his handle to a position which stops the fireworks. The method has been found so satisfactory that at this time the company is equipping seventy-five more cars with that type of control. The work that has been done by the manufacturers to reduce the size of the type M and pneumatic control has been very satisfactory. Both have made rapid strides in getting these two types of control so that they can be placed under ordinary city cars. There is still work for them to do, and with that in mind the Milwaukee Company decided that it would be better to equip another seventy-five cars with the type of control originally described. Mr. Olds also said that his company, as mentioned last year, was using individual fuses for each motor; so that, should a short-circuit occur on any of the motors, the fuse protecting that motor would blow. This has also been found to be very satisfactory. With the old type, an arc would often be started from a short-circuit, but its resistance would be so large as to cut down the amperes so that the circuit breaker main fuse would not blow, but the fireworks would continue. With the individual fuses, one of them will blow should a short-circuit occur, which of course stops the burning.

President Adams said that the first part of the year the Baltimore Company put in service forty equipments of the same type of control. They were four-motor equipments on cars that are 30 ft. 8 ins. over corner posts and weighed about 49,000 lbs., with four 65-hp motors. At the same time the company put in service 160 equipments of four-motor cars, weighing about 45,000 lbs. with four 40-hp motors. These equipments had the K 28-b control, and the first had type K 28-f control. Excellent results have followed the use of the K 28-f, or the contactor combination. There have been no fireworks; there is considerable saving on the cylinder and the contact fingers. This is in spite of the fact that the cars have been in fairly heavy service this past summer.

F. E. Case, of the General Electric Company, said his company had furnished multiple-unit equipments for a large number of cars that were not intended for multiple-unit operation on account of the ability to put the apparatus under the car, and in consequence the freedom from danger of protecting heavy currents on the platform. Outside of the elevated roads and some of the steam roads which ordinarily, of course, would operate trains, probably more than 50 per cent of the equipments have been for single car operation. The railways in many instances have thought that ultimately they would run two cars or perhaps three cars, but after operating for several years, many of them have not added the second car, largely, he thought, due to the trouble of the draw bars, on short curves, such as exist in ordinary street car practice. The control not only provides a greater factor of safety so far as not arcing, or causing actual damage, but it also removes the arc to a point where the passengers will not notice it, should any such arc occur. In connec-

tion with the type K 28-f controller in which contactors are used under the car to assist in opening a final circuit, some cars have been equipped in addition with an automatic switch or circuit breaker located in the vestibule which will open the control circuit when an excessive current flows. This permits the contactors to drop and operate as a circuit-breaker. At the same time, these contactors operate each time the controller is turned to the first point. In many of the equipments which have been furnished, not only does the control open on the first point, but also during the transmission from series to parallel.

W. H. McAloney, of Denver, asked Mr. Case whether if he were using one-way cars, where he did not consider the cylinder platform controller as objectionably as on double-end car, and he had K-10 and K-6 controllers and used two 50-hp motors, what switch box or controller he would consider is best adapted to the 100 hp?

Mr. Case said the K-11 controller is the one that his company furnishes for use with two 50-hp motors. There is no doubt that the addition of the two contactors will greatly benefit the operation, as they will assist in opening the circuit under the car, but there is not the necessity for these that there would be perhaps on an open car where passengers use the front seat.

E. W. Olds said in Milwaukee they operate cars double end. Mr. Case spoke about cars with 200 hp or more. In Milwaukee cars are equipped with 160 hp. The speaker did not believe it is safe to operate the cars with the ordinary K type of controller without something in the circuit which will open in case of trouble.

Paul Winsor, of Boston, said the Boston Elevated Railway Company had thought for some years that the platform controller was not a safe thing to use even on a moderate-sized equipment, and a year or more ago it fitted up forty cars that had 65-hp motors with multiple control. There was considerable trouble with those controllers at first, principally through a lack of pressure on the contact and improper function, but that has been pretty well weeded out now, and those forty cars are giving very good satisfaction. The company is now equipping fifty additional cars having larger motors with multiple control. The company is also experimenting now with two cars coupled together, using an extra set of contacts and extra contact plates in the reverse circuit on the off position. The two cars are coupled together permanently with a solid draw-bar, which does away with the fenders, scrapers and platform controllers between the cars. With the extra set of plates on the off position of the controller, it is possible to control from the front platform two motors on each car with three wires between the cars. This is only an experiment. The multiple controllers are giving very good satisfaction now that some of the troubles have been remedied. The company does not believe that the platform controller is hardly suitable for any size of motors. There is trouble not only in case of short-circuits or partial short-circuits, but also when passing from series to multiple where one set of wheels is spinning. If the motor that is short circuited is spinning its wheels, there is a very heavy current in the short-circuit.

Mr. Case wanted to add that he did not mean to infer that his company does not recommend the multiple controller for less than 200 hp, but the point was that, below that size the cost is relatively higher than when the total motor capacity is larger. From an engineering standpoint, he should much prefer to furnish the multiple-unit type of control for all cars. As a matter of fact, the company has equipped cars having two motors of 40-hp capacity with this system. There is no doubt at all that it is a very proper system to use from an engineering point of view and from an operating point of view, although the first cost is probably greater.

President Adams asked Mr. Case if he has been able to get this multiple unit controller reduced in size and weight for the single-car equipment.

Mr. Case replied that his company has gradually reduced the weight of the equipment during the last few years. When it started out on the Interborough equipment, which was one of the very early ones, the contracts were brought into about 12-ins. space, and there were thirteen of them on the car. These were finally cut down to less than one-half, and all of the contactors were placed in three boxes. On the second order of cars for this road, on the subway division, these equipments were provided. Then as a next step, all of the contactors were placed in a single box, completely wired up ready for installation. This did not materially reduce the weight, however, except that there was no necessity for providing cleats on the bottom of the car for supporting the wires, and the wiring itself was greatly reduced on that account, thereby reducing the expense of installation. The company is gradually making reductions in the weight of the various parts.

The president then invited a representative of the Westinghouse Company to speak in regard to the multiple-unit control that that company is putting out for single-car units.

William Cooper, of the Westinghouse Company, agreed with the remarks made by Mr. Case in regard to the general subject, but he thought that in placing the limit at 200 hp Mr. Case had put it a little bit high. He could not see any reason why multiple-unit control should not be as successful on smaller equipments provided the controller is small enough to meet the conditions. As a matter of fact, the point of getting all of the higher voltage wiring and the main circuits under the car and keeping them off the platforms seems to be the main consideration. If the controllers could be made small enough so as to go on an ordinary car it would seem that it would be a desirable thing to do. His company has developed a controller which is small enough to go on almost any car. It has a capacity of two 100-hp motors, or even more, up to about 300 hp, total. The controller is 16 ins. long, 14 ins. wide, about 15 ins. deep and weighs from 300 to 325 lbs. That is not an excessive weight or size for almost any car. Of course there are some considerations which go with this matter as far as location is concerned. For smaller equipments a switch screw is used. For larger equipments, up to, say, four 75-hp motors, there is added what are called line switches for greater safety, and these are a part of the combination in the controller circuit. The largest installation made with that size controller is four 90-hp motors. In that case there are two separate line switches, and they are of about the same general construction. There is only one switch in each box. The line switches weigh 60 lbs. apiece. That equipment would seem to be adaptable for small equipments, and even if that turned out to be too large for small equipments there would be no question at all about making it still smaller. There seems to be quite a demand for multiple-control apparatus to go under cars for all sizes of equipment, and, there being that demand, of course it will have to be met. In the case of two-motor equipments, there is an overload trip in each motor circuit. The little switch groove is equipped with two overload trips, one for each motor, or, in the case of four-motor equipments if the two motors are in parallel, the trip would be in the circuit of two motors. That would seem to solve the question of having an independent opening device of some sort in each motor circuit, as far as two motors are concerned in any event. This arrangement has the advantage, of course, of allowing the trips to be set for one-half the current, and there is less damage done in case of trouble. The trip operates to open all the contactors and cuts off the circuit from all the circuits of the car. It is all done simultaneously. There is, therefore, no reason why the General Electric Company should not build small control apparatus for this purpose when there is a demand for it.

Mr. Hall, of Boston, said that the Boston & Maine Railroad has been operating at Concord, N. H., for about five years, twenty-two cars 34 ft. over corner posts, equipped with type M control. These have been operated singly and in trains with very good success.

Mr. Winsor said that all the multiple-unit controllers used on the surface and elevated cars in Boston are of the automatic and not the straight type M.

Mr. Olds called attention to the fact that Mr. Smith, of Kansas City, had been operating the type M reverser, mechanically.

Mr. Smith said the use of this mechanical reverser had been suggested through the fuse in the winding of the reverser blowing at a time that the connecting rod of the air brake cylinder had broken. The fuse had gone some time earlier, but the motorman did not know it as he had run the car all day one way. The reverser is now connected by a system of bell cranks and levers to a lifting pull-lever on the platform, and the man has the car under absolute control, although his brake might fail at any time. The same has also been applied to all new equipment. Mr. Smith thought it very desirable on roads with grades.

Mr. Case added that the Kansas City equipment is a four-motor, and consequently there are two motors in parallel, so that when the reverser is thrown, it connects them so that they will generate. The same effect would not take place on a two-motor equipment, because the motors are not connected in multiple. The General Electric Company is now manufacturing the mechanism described by Mr. Smith, and also worked on a supplemental switch which would be thrown when the hand-operated switch was thrown, to connect the motors in multiple on a two-motor equipment, so that the same effect is obtained.

Mr. Olds said that while it is not exactly on the line of controllers, Mr. Smith's remark about the brake rod being broken,

suggested to him to say that the Milwaukee company does not consider it good practice to use the so-called single-end cylinder or cylinder with one piston. It uses two pistons in one cylinder, so that should the brake rod break, there are brakes on one truck in any case.

Mr. Smith said the Kansas City company does even better than that. It has put a brake cylinder at each truck, and also, not only as a factor of safety, but to get room to apply the hand-brake apparatus without connecting any part excepting the brake levers with the hand brake and the air brake; that is, the hand brake is absolutely separate from the air.

President Adams then announced the next paper on "Ties, Poles and Posts," by C. A. Alderman, chief engineer, Cincinnati Northern Traction Company, Cincinnati, Ohio. This paper will be found on page 703.

Prof. A. S. Richey, of Worcester, thought that Mr. Alderman's paper surely means that it will soon be necessary to begin to treat ties, poles and posts, in fact timber used in construction, in some way to increase its life, or else we will have to go to some other material, steel or concrete or a combination of the two, for the purposes for which wood has been used. A day or two ago he had occasion to walk over a quarter of a mile or so of electric railway track within a couple of hundred miles of Columbus, and saw some pretty good ties and also an illustration of trouble in both posts and poles. He noticed a rattling in the wire fence that was along the right of way, and ahead of him a couple of hundred feet was a horse that was pretty anxious to reach some green grass that was on the right of way. The push that the horse gave the fence broke off a couple of posts in the ground, and he came on over into the right of way and got his grass. Those were cedar posts about 5 ins. at the top, and had been in less than three years. The soil was the ordinary good black farming soil that is common in this part of the country. Of course the fence post problem is the least important of the three mentioned by Mr. Alderman. It is undoubtedly true that the end post on the fence, and the method of putting them up and of stringing the fence is of 75 per cent more value to the fence than are the posts and the method of setting them between the end posts. Just a little further along this walk that he was mentioning, he saw a 50-ft. pole that was pretty badly twisted and lying on the ground. That was not the fault of the pole, however, but its location, which was just beyond a derail at a steam railroad crossing, and the derail had operated and the pole was hardly sufficient to stop the car, which had evidently run into it. Mr. Kelsey, of the Indiana Union Traction Company, has proposed the use of a steel lattice pole about 42½ ft. long, to carry the trolley brackets that are used for telephone and alternating-current wires, the pole being constructed as a three-legged tower, sort of a wind-mill tower. That pole weighs about 500 lbs. and will cost about $20. He proposed to use those poles in spans of about 200 ft., and use catenary construction on the trolley wire that is on the straight line. The telephone and lighter wires, of course, would have to be spaced out on the cross arms to keep the vibration going across to them. But it is probable that some such construction as that will be more economical than the use of wooden poles at the rate at which the price of wooden poles are going up, and considering the relatively short life of wood as compared with such a steel tower set in concrete. He knew of some cedar poles which had been in use in the ordinary span wire construction on city streets that were examined during the last summer, as some had been breaking off. The poles had been set about thirteen years. Each pole was closely examined around the surface of the ground, where the rotting generally takes place first, and just below the surface of the ground. Probably about one-half of these poles showed evidence of having been painted with some sort of paint when they were put in. Others did not show it. In almost every case the poles which did show evidence of having been painted were in a great deal better condition, in fact hardly rotted at all at the top of the ground where the others were badly rotted. This seemed to indicate that even the protection of some sort of paint did keep the moisture out at the top of the ground, and did a great deal of good in that case. In the concrete pole that Mr. Alderman suggests, drawings of which are given in his paper, the form is in a horizontal plane, possibly when the pole is made. He would like to ask for information whether the pole would not be better if the concrete could be rammed up with the pole in an upright position? As to the matter of steel and concrete ties, the experiments in this country have not been very extensive. Some of the railway journals indicate that abroad, especially in Germany, the number in use has been increasing pretty rapidly each year. They may perhaps be in the nature of experiments yet. It is probable that the matter of the proper fastenings for the rails to the concrete tie will be as much of a problem as anything else. The construction of track in city streets on concrete beams or some sort of concrete foundation is being carried on quite extensively, but this is probably not so much on account of the cost of the ties as the cost of renewing the ties where such track is built under the pavement. In strictly interurban work the tie question is very similar to the tie question that the steam roads have had to fight out and are fighting out, and Prof. Richey thought it would pay to watch the experiments that the steam roads are and have been carrying out on those lines pretty closely and reap the benefit of it if possible. It seems, as Mr. Alderman says, that the steam roads in this country at least have probably come to the conclusion that creosoting wood ties pays better than the use of steel or concrete ties.

Mr. Simmons, of Milwaukee, thought that there was some force to the argument advanced by Mr. Crump, of the committee, that the creosote post forms a better conductor, that is, that it is not advisable to creosote a pole to its entire height. We all know that the life of a wooden trolley pole is dependent almost entirely on the action of decay at the ground line, and if a post is subjected to a preserving process which will carry to or slightly above the ground line, the objection as to its conductivity from the trolley down will be overcome. In Milwaukee on the interurban lines, as well as on all other places where the company is employing poles for lighting purposes all of the poles are set in concrete, and that concrete is brought to or a little above the ground line. A collar is then placed 2 ins. or 3 ins. in depth and about 1 in. in thickness all around the pole where it projects above the ground, thereby forming a channel which is later filled with paving cement or tar mixture. In doing this the company prevents the cracking of the concrete base, which is easily smoothed off and made sightly at the ground line. The base is formed up on a slight elevation and the water or moisture passes away rapidly, and there is very little resulting decay, or, rather, this process puts off the period of decay to a much greater length of time than would ordinarily be the case. Nevertheless, Mr. Simmons was inclined to doubt that this is all the precaution that might be necessary. He thought that the process of injecting the base of the pole with a preservative fluid to a short distance above the ground might be advantageous.

Mr. Lamb, of Toronto, described some concrete pole work that is being done at St. Catharine, Ont. They have a very deep valley running through the center of the town across which a 20,000-volt line is going. To save going down and following the contour of the ground they decided to put up two 150-ft. poles, which they built of reinforced concrete. These poles are, roughly, about 2 ft. square at the base and tapered. They are square throughout, except for the tapering and a slight bevel on the corners. They weigh somewhere about 55 tons apiece. They were built on the ground horizontally, and then raised by means of a derrick. They broke the first one putting it up because they did not pick it up at enough points, but they remedied that afterwards. Two poles are now up, and so far are doing very satisfactory work.

Mr. Kelsey, of the Indiana Union Traction Company, said that the pole proposition is becoming of some magnitude with that company, and principally as an item of freight. It is important to get some substitute for the cedar pole. The company's standard of pole construction is a 7-in. top, 40-ft. pole, carrying bracket and trolley and one or two high-tension lines. The question occurred to him whether or not it would be practical to build a concrete pole when such pole would be necessary about 40 ft. high, whether such a pole would necessarily have to be so very large at the base in order to be stable in the ground or be in perfect alignment, especially in installing such a pole on a green grade, or a grade that had not had time to settle. These poles would certainly get out of alignment worse than cedar poles, especially if they started to get out of alignment, on account of their excessive weight, unless the base of the pole was made very large. For that reason he thought that the steel tower, with the feet spread possibly 5 ft. or more, would make a more stable construction and possibly be as cheap as the concrete pole if the concrete pole had to be made very large. He inquired of anyone who had had experience in constructing concrete poles, whether or not a concrete pole built to replace a 40-ft. 7-in. cedar pole would have to be reinforced with steel, and if so, how much steel is required, also the life of the untreated poles.

Mr. Simmons said that in Milwaukee in about ten miles of road in which white cedar poles were placed between eight and nine years ago, and spaced a little over 100 ft. apart, about 6

or 7 per cent of them only showed a necessity of replacement on account of rotting at the ground line. These poles were placed without any protection at the base. On another line, in which the poles were placed without protection at the base, the poles show no deterioration at the ground line after eight years.

E. J. Dunne, of the Public Service Corporation, of New Jersey, said experience on that road with good sound, first-class cedar poles was that the average life would run from fifteen to twenty years. He had taken poles out of the ground when they were twenty-five years in service, and found them in fair condition. That would not apply, however, to street railroad work, but this refers to poles used on telegraph lines. It may not be safe to let poles stay that length of time for side-hole suspension, but it is safe to say that good white cedar posts would be good for fifteen or twenty years. The company has had some experience with the concrete butt, and he thought it is all right for bracket suspension. A good pine pole, with a concrete butt, will make a good substitute for cedar for bracket suspension, but he was not ready to recommend it for span suspension at the present time.

Thomas Hawken, of Rockland, Maine, recommended Mr. Simmons' method of setting poles in cement. He believed cement is one of the best preservatives known. He had seen a pine pole that had been set in cement, which had been in use for thirty years, which was badly decayed at the top but when cut down was found to be sound at the bottom. In his opinion yellow cedar, such as the Michigan cedar, is the longest lived of any of the cedars, and white cedar is the shortest lived.

H. B. Fleming, of Chicago, said his company had several miles of white cedar pole line, practically all within the city limits, and it has been in service since 1898. The majority of these poles are in fairly good condition at this time. A great many of the street poles were removed when the streets were repaved and an iron tubular pole was substituted. In the early days of the use of tubular poles in Chicago a ferrule was placed around the pole at the ground line. The pole was set in cement and this ferrule was placed just at grade. After the pole had set there was a space of possibly 2 ins. between the outside of the pole and the inside of the ferrule which was filled with a bituminous compound. After these poles had been in service for several years it was found that there was a tendency for the iron pole to rust out at the top of this ferrule or iron collar. Since then the use of the collar on the base of the iron poles has been discontinued.

Mr. Winsor, of Boston, said that his company is just beginning to use iron ferrules at the base of iron poles, because the poles are rusting away at the base, and it was thought that by using these ferrules the poles could be strengthened. The Boston company has poles which have been up for twelve years, set in concrete, and some of these older poles had rusted off on the ground line. The company is reinforcing 700 poles with ferrules spaced one-quarter or three-eighths inch from the pole, and filling that with liquid concrete for strengthening the iron poles that had rotted out.

Mr. Simmons suggested that possibly an explanation of the undue corrosion of the iron poles which Mr. Fleming described may possibly have been due to the nature of the compound used in the collar. He did not know what the nature of this compound was precisely, but the paving cement used in Milwaukee is ordinary gas-house paving cement such as used in making brick pavements, is mixed with sand and is placed in this collar formed by the ferrule around the pole. The corrosion formerly occurring where the concrete reached the pole directly has been overcome during the length of time the company has had experience with that compound, which is probably eight years.

President Adams then announced the paper on "Ballast," by Charles H. Clark, engineer of maintenance of way of the Cleveland Electric Railway Company, Cleveland, Ohio.

Mr. Clark presented the paper which is published on page 700, and at its conclusion said: "The photographs have an explanation on the back, but these were not printed. Photograph No. 1 shows tracks laid in a street with cinder foundation, no ballast, no concrete, or anything but the cinders between the ties. This track was laid with the expectation that a sewer would be built there, which is now under way. The paving stones are dropped between the ties. No. 2 is the track just laid on the common soil, and tamped with common soil, nothing between the ties. The rail and ties have gone down. No. 3 is about the same thing, only with brick pavement. It shows the bricks as they have come up along the rails. No. 4 is a 6-in. rail on concrete and the chairs, but this rail has gone down, showing that the track could not have been drained. No. 5 is about the same, with brick pavement. No. 6 shows tracks which are laid over a sewer and the sewer settled. You will notice that the paving stones on the left and right are 1½ or 2 ins. above the rails. No. 7 shows a construction of Carnegie steel ties, and the ties spaced 4 ft. apart. I am now spacing them 6 ft. apart. No. 8 is our standard construction with the white oak tie, with solid concrete under and between the ties. This track was laid in 1903, and the paving has not been touched since then, and I do not believe it will be touched for the next ten years."

Mr. Simmons, in the discussion of Mr. Clark's paper, said that the last phrase in the paper corresponded exactly with his own belief and with the practice in Milwaukee. Mr. Clark says: "And when the traffic can be kept off the track, that a solid foundation of concrete, made in the proportion of at least 1-3-6 with best Portland cement. Bring your concrete up to within 1 in. of the bottom of the pavement. The first cost of your foundation may seem large, but the cost of the annual maintenance thereafter will be greatly reduced." The practice in Milwaukee is just as outlined in that statement. There they use, not white oak ties, but cedar ties, and space them the ordinary distance, 2 ft. from center to center. Six or 7 ins. of solid concrete are put under the whole trench, to bring the whole concrete up around the ties, and in the case of the 7-in. rail an inch above the ties. They then use a 5-in. block, or a 4-in. brick, in the ordinary construction, in which case the concrete comes up still higher, and he believes in using that style of construction the twelve years ordinarily designated as the period of life of the cedar tie has been overcome; in other words, that the concrete preserves the wood of the tie whether white oak or cedar, to such an extent that its life becomes almost indefinite. The company has taken up track that has been laid under almost similar conditions to that, where the cedar ties have been in sixteen and eighteen years, and has replaced right back into the construction anywhere from 40 to 60 per cent of the same ties and encased them again with concrete, and has had no difficulty with them. He also agreed with Mr. Clark's final conclusion in the matter of ballasting in city construction, but thought it also advisable to take up the matter of ballast on interurban lines, which is an entirely different proposition, and one more like that on steam roads. The American Engineering and Maintenance of Way Association has recently issued a bulletin on this subject. Among other things, they take up the ballast and classify it as the sand or gravel ballast, and they make an exact specification as to what sand or gravel ballast is. Their method is to describe certain classes of gravel according as the gravel will pass through a certain size of mesh, or lodge on a certain size of mesh, in a screen. In dealing with stone ballast they do the same thing.

In specifying stone ballast they classify it as follows:

Stone ballast; recommended specifications: First, quality. (a) Stone shall be sharp enough to resist the disintegrating influences of the climate where it is used. (b) It shall be hard enough to prevent pulverizing under the treatment to which it is subjected. (c) It shall break in angular pieces when crushed. Second, size. (a) Maximum size of ballast shall not exceed pieces which will pass through a screen having 2-in. holes. (b) The minimum size shall not pass through a screen having ¾-in. holes. So they give definitions as to sand ballast and state what it shall be, and take up the different classes of ballast which may be the most available material for the particular locality. The American Street and Interurban Railway Engineering Association can not lay down a standard form of ballast. It can simply state that there are a certain number of forms of ballast, burnt clay, slag, whatever it may be, that is most available at the time, and then try to show the engineering fraternity what treatment that particular form of ballast should receive.

C. A. Alderman, of Cincinnati, as the representative of an interurban road, said that in Central Ohio during the past few years the roads have inclined to the belief that concrete under the tie was not the best thing to use. He feels that concrete under ties is an almost impossible proposition from the standpoint of getting good, permanent track. The different companies with which the speaker has been connected have been quite uniform in their conclusion that a well-ballasted track with something besides concrete was the best thing either in city streets or in the country. They lay the concrete wherever necessary, of course. His company is now laying some track in the city of Columbus, using solid concrete bottom under the

T-rail. It is doing this against its own wishes, but the city made the concession of allowing the company to use the T-rail and the company conceded to the city the concrete under the rails. In the speaker's opinion concrete for heavy interurban cars, weighing 70,000 lbs., and going at a good rate of speed, is not an easy thing to get in in such shape that it will not break up, and when it breaks up it becomes loose, disintegrates, and it is not much better than using so much ashes under the track. He believed it was a very hard thing to get a track laid with as little as 6 ins. of concrete under the rail that would stand the traffic of interurban cars coming into the city. Several cities in the neighborhood of Columbus have specified gravel and broken stone for ballast, and have discarded the concrete. The city of Dayton allows nothing but T-rail, with gravel or broken stone ballast. Indianapolis is not quite as pronounced as that, but the roads are laying a great deal of track there with gravel and broken stone ballast. In Columbus, if the company lays T-rail the authorites require concrete ballast. If the company lays girder rail they will sometimes allow gravel. The city of Cincinnati is experimenting with track laid on broken stone ballast, and nearly all of the smaller towns through which the interurban cars pass are allowing gravel ballast to be used instead of concrete. Mr. Alderman thinks there are many arguments in favor of loose ballast instead of concrete. In his judgment it makes a better riding track, more easily repaired, and it does not break to pieces. It can be laid in cold weather, and if properly laid it will answer the requirements.

Mr. Clark, of Cleveland, asked Mr. Alderman what were the proportions of the concrete used in Columbus.

Mr. Alderman replied that a 1-2½-5 Portland cement mixture was employed.

Mr. Clark, of Cleveland, said he had considerable experience in the use of concrete, in dam and other work, and in one 60-ft. dam has used the proportions 1-3-5. This had stood up well. One of the speakers thought that concrete would be pounded up. Mr. Clark did not believe it would if the right proportions were used and the material was measured accurately. It is not enough to throw it together in wheelbarrows and try to see how cheaply the work can be done. If concrete is made carefully it will not disintegrate. On the Lorain Street tracks in Cleveland the concrete has been down four years, and when it became necessary recently to take up some of the track they had to take the concrete out with chisels and sledges piece by piece. The Cleveland Southwestern cars have been running over the tracks for four years and these cars are as heavy as any cars in the country.

J. M. Larned, of Pittsburg, stated they do not use very much concrete in Pittsburg. The ties are placed on a stone ballast in the good old-fashioned way, and where the pavement is to be supported on the heavy traffic streets concrete is placed between the ties, but they are not attempting to support the ties with concrete at the present time. His personal belief about the use of concrete is that any track, which has had as much money spent on it as is necessary to build a concrete track, should last without attention for five years. A good track can be built on rock ballast, which will last under a city street for eight or nine years without receiving any attention, so that a life of four or five years of the concrete under the ties is not remarkable.

E. B. Kirk, of Oshkosh, asked Mr. Alderman if he believes in using thin gravel to fill the voids in the crushed rock ballast, and whether he has found in using crushed rock of 1½-in. size that the sub-soil works up into the voids?

Mr. Alderman replied that the only places where they had to use broken stone has been in the Northern part of the State. All through the Central and Southern part of Ohio excellent gravel is obtainable and this is considered to be as good or better than broken stone. If it is absolutely necessary to use broken stone, the idea of using gravel with it is very good. The practice is to use broken stone where they cannot get gravel and use gravel where it is found. Any ballast, of course, is liable to mix with the soil underneath it, and that is the great trouble with the roadbed, to keep it so that the ballast will stay there after it is placed there. In a well-ballasted track, however, in city streets, they do not find that the gravel or broken stone pounds down into the soil as much as it does on grades outside of cities.

F. G. Simmons, of Milwaukee, answering several of the criticisms regarding concrete for ballast, said that, while admitting the force of Mr. Alderman's arguments as to using a loose ballast, his company believes, nevertheless, that the efficacy of a concrete ballast is a matter of workmanship; and answering Mr. Larned's statement that concrete has not been used a sufficient time to pass judgment on it, said that in Milwaukee they have construction similar to the kind he mentioned, their standard construction with 6 ins. of concrete under the ties and filled up between the ties and to a point where the pavement is superimposed with an inch cushion of sand on the concrete, that has been in nine years and there is no sign of trouble. They welded the joints (this is in city streets of course) and have not even thought of repairing the track. They try to have the concrete mixed in the combination of 1 part best Portland cement, 2½ parts of sand and 5 parts of rock, and with this mixture and by keeping the cars and all traffic off of the tracks for a sufficient period of time to allow the concrete to become well set, the results have been very satisfactory. If it is possible to keep cars and other traffic off the track for six or seven days so that the concrete will have enough time to properly settle there will be no trouble with the construction afterwards. That also presupposes the proper treatment of the foundation below the concrete. In Milwaukee they excavate on city streets; they first excavate and then dig the trenches and they consider it necessary to make the foundation very solid. They roll it with heavy rollers, or tamp it with tamping bars, or flood it as suggested by Mr. Clark, and to be sure the foundation has settled to as great an extent as is possible they superimpose the concrete on the foundation, and then by keeping the cars off the track for a sufficient length of time they get the result they are after. They have some track which has been in nine years and do not expect to repair it for nine years more. They run interurbans over this track.

H. B. Fleming, of Chicago, speaking of cedar ties, said his company had some cedar ties which have been in service since 1887, and two years ago when it was necessary to take out that track on account of the construction of a new sewer, the ties were found so well preserved that they were replaced in the track. The only objection to cedar ties is that, as the wood is soft it is hard to hold the gage. This agrees with Mr. Simmons' experience with the cedar ties. The speaker also called attention to one thing in connection with steel-tie construction. Companies go to great expense in building a sub-structure for the track, and in many cities where the traffic is very heavy the rails wear out in a very few years. It seems to the speaker better so to design the sub-structure that it will be possible to relay the rails without relaying the sub-structure. He even thinks it would be quite advisable when using the steel-tie construction similar to that proposed by Mr. Clark, that there be inserted under the rail, and on top of the tie, a renewable plate which will make it possible to relay the rails on that tie without resurfacing the tie. Mr. Clark suggests in his paper that the rails are liable to be eaten away. He probably refers to the electrolytical action which would take place there, but at the same time if the rail gets loose on the tie there is a tendency to wear away the upper surface of the tie and there should be inserted a plate between the base of the rail and the top of the tie which could be renewed at the time the rails were renewed.

Mr. Clark believed that that matter can be taken care of when relaying the rails by using different size shims. That is the reason he spoke of leaving sand holes in the concrete so as to take out the bolts. It might be necessary to use different size shims. The rail can be picked out of the steel tie clips and relaid easily without resurfacing any more than shimming up. He shimmed up about 14 miles of old cable track two years ago that was mounted on yokes. The rails were welded by electricity and shims were driven on top of the yokes to bring the rail to surface.

Mr. Fleming did not agree with Mr. Clark on the shimming proposition. He has had experience on that line and he found the shims themselves are soon destroyed and the track goes down to the original sub-structure.

Mr. Alderman asked what had been the experience with concrete beam construction?

Mr. Simmons replied that from personal experience and observation he has been so unalterably opposed to concrete-beam construction heretofore that he has never employed it.

Mr. Clark was also opposed to concrete-beam construction.

M. A. Schreiber, of Newark, said the Public Service Corporation believes in stone ballast under the tie. They have an exceptionally fine quality of trap rock, and put the trap rock under the tie, and for paving they put concrete between the ties. They rebuilt many miles of track this summer and had an opportunity to look over a good many different sorts of construction put in by different companies. His company has used altogether the wood tie, either good quality white oak or chestnut. In laying down a track there are two things to be considered: not only to put down a good track, but to think of the effect on the rolling equipment. The track must not be too rigid. He thinks that concrete under a tie is not a good thing, because the concrete, subject to impact, will not stand.

Mr. Alderman thought that where the metal tie was used there will be more necessity for using a cushion ballast.

Mr. Simmons fully agreed with Mr. Alderman's last remark. He believed, however, that the amount of cushion effect given by the use of the tie is all that the pavement can stand, and if to the cushion of the tie there is added the cushion of the loose ballast, there will be too much vertical motion in the rail and the pavement will be unduly disturbed. The matter of cushion is a vital one, and that is one reason the speaker has always maintained that a metal tie was only a last resort on account of the increasing price of timber.

Mr. Clark, of Cleveland, thought that if a company had 64 sq. ft. of pavement to maintain, 16 ft. wide in the street, it would find the cost of maintaining the pavement would be in excess of the cost of maintaining the equipment on the cushion track. If the track is perfectly rigid so that the pavement does not move, the cost of maintenance will be little for the pavement.

Paul Winsor, of Boston, said there is one thing which should not be lost sight of, and that is the matter of water-proof pavement. It has been the experience in Boston that unless precautions are taken to keep the water out of the ballast there will be trouble. The pavement must be tight. He finds that concrete pavement set in concrete blocks will preserve the track very much, because the water does not get in and does not churn under the ties and the foundation stays "put." It is water in the track that is the cause of most of the troubles, and the important question is to keep the water from getting into the foundation of the track.

Mr. Clark called attention to a new joint which had been used in Cleveland and which was on exhibition during the convention.

The report of the committee on maintenance and inspection of electrical equipment was then taken up. This report will be found on page 718.

President Adams stated that the association was indebted to Mr. Doyle for the figures and data submitted in the report.

Mr. Winsor, of Boston, said his company had gone recently onto a mileage basis of inspection, both for the surface and the elevated cars, which is working out very well. On the surface cars, the night starters at the various stations keep the mileage. They use the register sheets for that purpose. The fare-register sheets are made up by car numbers, and each sheet stays with one car through the various routes that the car runs during the day, so that by knowing the number of trips the car ran on each route, and referring to a mileage table of routes, the starter can very easily make up the figures. He enters on a card each day the mileage made that day, and the total to date for each car, and sends the cards every morning to the car-house foreman, having checked on each car the cars that have run up to the inspection mileage. This has been found to work out very well. This mileage inspection takes the place of the inspection they used to do every three days, and includes brake-shoes, controllers and such things as were apt to give the first trouble. It is not a general overhauling at all, although that is also done on the mileage basis, but at much longer intervals. The company has all kinds of equipments, and some of these have to be treated in one way and some in another, so there is no uniformity on the road among the different houses as to what mileage a car makes before inspection. One kind of equipment may have to be inspected at 300 miles, and another equipment will stand a good deal more.

Mr. Kirk asked if cars were oiled between inspections.

Mr. Winsor replied that they have certain motors that have to be oiled more frequently than that; in fact, they have to be gone over every night. It depends entirely upon the equipment.

Mr. Doyle, of New York, said in their equipment the motor bearings and the armature bearings are oiled every 1000 miles, irrespective of time, and the motor axle and journal bearings are oiled every 10,000 miles. They do not need to oil bearings between inspections.

Mr. Olds, of Milwaukee, thought that the matter of inspection at the present time is one in which it is impossible to lay down any hard and fast rules. It is one that has to be worked out to a certain extent for each locality. The work of the standardizing committee will be instrumental in reducing the cost of maintenance of cars. The speaker had been able, by using an oil cup with a wick feed, to increase the life of the bearings about three times over the old grease method, but the oil cup is not as good as the use of wool waste, as is possible on the newer types of motors.

Mr. Kirk asked Mr. Olds whether he has had any trouble with the oil not feeding up on the wick in zero weather in these oil cups.

Mr. Olds replied that he had not. The oil cups are made of cast iron with a tube in the center, which is also cast. There is a wire in the center of the tube with a loop in the end next to the bearing and going to within about ⅛ in. of the bearing. Passing through this loop are two or three strands of wool yarn. There has been no trouble on account of not feeding.

Mr. McAloney thought that many of the smaller matters, as brush holders, commutators, etc., gave more trouble than the bearings, and these were the things that should receive attention in the inspections.

Mr. Doyle thought the system of maintaining cars on the mileage system could be made very simple if put on a basis of car trips. Most companies pay as much attention now to the car that makes two trips a day as to a car that makes twenty trips, and the minor troubles, no doubt, are aggravated very much more on the cars that do twenty trips than on the cars that do two.

President Adams also spoke in favor of the mileage inspection system, especially for the newer types of equipment.

Mr. Winsor thought the gentleman from Denver was correct in stating that most of the breakdowns come in the old equipment from such things as brush holders. Heretofore everyone has been a little afraid to tackle this mileage proposition. It looks as though it was almost an impossible thing to keep the records with the class of men employed on the cars. Due to Mr. Lindall, of the Boston Elevated, however, that company has been able to put in mileage inspection. More than that, it has been able to tabulate the failures, and at the end of the month it is possible to know the number of failures of each kind; how many there were last month and the month before, and the month before that, by comparison. In that way, at the monthly meetings, with the car-house foreman, these subjects are taken up, and if it is found that the W. P. 50 brush-holder troubles, for instance, are growing, that matter is taken up with the foreman and with the machinist, and steps are taken to improve that brush holder or to improve that inspection. But this whole question of getting this down into proper shape has been a bugaboo for many years. The speaker could say from his experience, and the mileage system has only been running about a year now, that it can be carried out with good results.

Mr. Olds said that had been the same proposition on his road. It seemed to be almost impossible to get the mileage in such a manner that it could be determined readily, and the accounting department, which keeps the mileage, has been handicapped in a way that has made it almost impossible for them to give that information. The speaker hoped in another year to have some data on the operating of cars or inspecting them on a mileage basis. He is a firm believer in it, and believes that it is the only system to use.

Mr. Winsor said he had made up his mind that he could not depend on the accounting department to give him the mileage. It was necessary to have the report early each morning. Therefore, on his road the mechanical department keeps the mileage records in the car house. This is done readily from the register sheets. The night starter's business is to get the sheets together and send them in the first thing in the morning to the auditor. The mechanical clerk draws off from this the number of trips that each car made on the various routes. From this it is a simple matter to work up the mileage.

The meeting then adjourned to meet Tuesday morning at 10 o'clock.

TUESDAY MORNING SESSION

President Adams called the meeting to order at 10:20 o'clock on Tuesday morning, and said that the first business of the morning was the report of the committee on standardization. H. Wallerstedt, of New York City, the chairman of the committee, was unable to be present, and J. M. Larned, of Pittsburg, read the report.

Mr. Larned presented the report, which is published on page 719. President Adams called attention to the last clause of the report: "It is the hope of the committee that the companies which have not already returned the data sheets will give them prompt and careful consideration." That, he said, is the whole thing in a nutshell.

Mr. Olds, of Milwaukee, said the selection of standards was of a great deal of importance, and that brake-heads, journals and journal boxes could be very easily standardized. The Milwaukee company's standards were made ten years ago, and its man-

agers have seen no reason to change these standards, except by adding to the other M. B. C. standards as its equipment and cars has grown heavier. The company started out ten years ago with what seems now to be very small journal box-bearing brass. It was the 3½ x 6 journal, and it has since added to that the 3¾ x 7 and the 4¼ x 8, and at the present time is getting out some very heavy equipments, which will be 5 x 9. All of them are M. C. B. standards. It has always insisted that any equipment made for it, whether it be a snow-plow or a passenger car, work or other car, should be equipped with some one of these standards. In the way of brake-shoes, the company adopted a Christie head, making such changes in it as was necessary to meet the electric railway conditions. Ten years ago the company had seventeen kinds of brake-shoes in use, but has not been obliged to order very many of these shoes during the last five or six years. It does not, however, believe that it is good policy to discard all of its old equipment, and prefers to wear it out. It is never advisable to throw away equipment that will give good service. It will become obsolete and go to the scrap heap quickly enough, no matter how good it is. Mr. Olds believed that the standardization committee will, with but little trouble, be able to recommend standards, particularly in those matters mentioned, which can be adopted. The face of the brake-head can be such as to receive the same shoe on different kinds and types of trucks; the attachment of the brake beam or the lever can be varied, but it is a very easy matter to make them so as to use the same brake-shoe. As far as motor parts are concerned, that is a much harder proposition to meet, but Mr. Olds believed that the electrical equipment manufacturers are more than ready to meet the engineers on this proposition. If large companies are able to agree upon some standards, it will lessen the cost of the equipment, which, as all know, is a very important matter. It will also lessen the cost of maintenance. Mr. Olds said he was pleased to receive this report, and note the progress of the committee, and thought it had done well.

President Adams called upon Mr. F. W. Sargent, of the American Brake Shoe & Foundry Company, to discuss the advantages that might be derived from more standardization of brake shoes.

Mr. Sargent said that, as a manufacturer of brake-shoes, he could say that there is a tremendous waste and expense incident to the present practice in regard to brake-shoes. He referred particularly to the difference in patterns. A large number of roads use the combined head and shoe, weighing all the way from 30 to 50 lbs., and scrap it when less than half worn out, and that is a loss, especially where high-priced shoes are purchased. It is possible to separate most of these combined heads and shoes, and a number of the roads are working along that line, but the separation has not been in the lines to secure the greatest economy. The shoes still remain very often a right and left-hand shoe, requiring two patterns, and the brake head is such it would not take the various shoes used by the same company. Mr. Olds spoke of having seventeen or eighteen patterns of these shoes in the past which were not interchangeable, and had emphasized the advantages which he has obtained by substituting a shoe on the Christie type and reduced his seventeen patterns to one. There are a number of roads in this country, principally in the West, which are following closely into the lines of the steam railroad practice, and are using a separable head and shoe, known as the Master Car Builders' Standard, in steam practice. That is in the line of the greatest economy in brake-shoe maintenance, because that shoe has the metal so disposed that it gives the maximum material for wear and the minimum for scrap. It provides a shoe that can be reversed on the brake-head, and there is a common head and a common shoe throughout the country, making interchange practical and possible without any difficulty; and it seemed to him wise for this committee to consider seriously the recommendations which they have made, or which may be made, toward the adoption of the separable head and shoe known as the M. C. B. Christie shoe. In such a case the shoe would not weigh more than from 20 lbs. to 24 lbs., which may be applied and removed at a scrap weight of 6 lbs., whereas with the combined head and shoe are generally removed at the weight of 15 lbs., or 20 lbs. From this proposed standard it is possible to get 75 per cent of useful wear against not to exceed 50 per cent with the other shoe. There is a steady saving of possibly 25 per cent at least in every shoe purchased. In view of the fact that the electrical lines are working in connection with steam roads, and, sooner or later, the electrical equipment will be running with steam equipment on steam lines, it seemed to him to make it very advisable that this association should hasten to go on record in the adoption of a standard for practice of brake-heads and brake shoes, and he could suggest no better practice than that which has been tried out in the years past on steam roads in so far as the Christie brake-shoe and brake-head are concerned.

President Adams then asked the secretary to read a communication from the Central Electric Railway Association, which was done.

Brake-Shoes.—We recommend the adoption as standard of what is known as Master Car Builders' standard type of brake-shoe, brake-head and key.

Journals and Journal Boxes.—We recommend the adoption as standard for journals and journal boxes the Master Car Builders' adopted standard so far as applicable to motor trucks for axle journals, known as 3¾ x 4¼ x 8 and 5 x 9. We further recommend the adoption as standard for these different sizes of axle journals the Master Car Builders' adopted standard journal boxes, journal bearings and journal bearing keys.

Tread and Flange Wheels.—We recommend the adoption of a wheel-tread 3 ins. wide with flange ⅞ in. high and 1 3-16 ins. thick at the throat for both city and interurban work.

Rails for Street and Interurban Railways.—We would recommend the adoption as standard of what is known as the "T" form section of rail for both city and interurban work.

President Adams suggested that the association should thank the Central Electric Railway Association for its kind consideration in this matter, and that the communication should be turned over to the committee. This was done.

Mr. E. W. Olds then referred to wheels. Ten years ago, he said, the Milwaukee standard was 1¾-in. tread x ⅝ in. x ¾ in. flange. That was supposed to be as large as could be used. He was very happy to state, however, that the treads have grown, little by little. At the present time the company is using for its interurban work a 2¾-in. tread with flange 13-16 in. deep by 1⅛ ins. in thickness. For the city work they are the same dimensions, except that the tread is 2½ ins. That dimension is growing and will be larger, and he hoped that within the next two years to come up to practically the recommendations of the Central Association. He wished it were possible to get at least a 3½-in. tread. In the older cities, where there is a great deal of the old work, it is nearly, and will be for a good many years to come, impossible to do so, but it will come. As has been stated, a company should be able to operate its cars upon the steam track, and this cannot be done until practically their dimensions as to wheels are used. In the matter of wheels themselves, a great many companies are using cast chilled wheels; others are using steel wheels. The steel wheel without doubt has come to stay, and will be, and is to-day, used almost entirely upon the interurban roads, and it will be but a short time before it will be used entirely on the city roads. One trouble that all have experienced is that it has been necessary to use just as heavy a wheel whether it was steel or cast iron, but he thought it better to make the wheels as light as possible.

President Adams then asked E. D. Priest, of the General Electric Company, to give his ideas on the standardizing of motor parts.

Mr. Priest thought that something could be done in that direction, although he saw it might be carried so far that it would work a disadvantage both to the manufacturer and to the user. He thought especially that something might be done in the matter of sizes of axles. A manufacturer has to keep in stock gears of various bores, but he cannot be expected to keep a full line, and quite often that fact may delay shipment of equipment, whereas if there be a standard gear, with standard bore and standard length of hub and standard key, it would be possible to make more prompt delivery, and it should tend toward a cheapening of the equipment. This is true not only as regards the gear, but also as regards the axle linings. If there could be a standard diameter it would be of great assistance to the manufacturers. If there could be a standard distance between wheel hubs, say the finished distance, it would also be of advantage to the manufacturers. The matter of clearance of wheel flange came up a few moments ago, and that affects also the clearance of the motor as between the motor from the armature shaft, extreme dimensions, and the clearance between the wheel flange. It would also be a good thing to have some standard gear ratio, but he doubted if that would be practicable, owing to the different characteristics of the service. Some day this may come, but he hardly thought it would come just at the present. There might also be something done in the direction of a standard size of cables leading from the motors in car wiring, and standard size of cables on the car. If the work was begun perhaps in a small way, not attempting to cover too much, it might develop into something to the ad-

vantage of both the manufacturer and the user along these lines.

In reply to an inquiry, President Adams said that he understood that this was an informal discussion of the subject, merely a report of progress.

Mr. Evans urged the association to adopt something which could go to the parent organization as a definite recommendation, and it appeared to him that it would be a simple thing for the association to adopt the steam railroad brake-shoe as standard. He said that he had used that brake-shoe quite as satisfactorily on 2-in. tracks as he had on the regular M. C. B. standard 3½-in. or more. During the next twelve months a very large number of equipments will be built, and it is extremely important that the output for the next year will conform to what may be expected to be the standard, and he thought it would be practicable to act upon the suggestion of the Central Electric Railway Association so far as it applies to brake-shoes.

President Adams thought it better to go slowly, rather than to take some action that all might not agree upon.

Mr. Smith, of Kansas City, asked what was the difficulty in putting a 3-in. tread or a wider tread into service at once. His company has practically the same conditions as many others, viz.: Trilby rail up to 137 lbs., girder rail up to 106 lbs., and the T-rail from 70 lbs. to 100 lbs. Yet it is running 600 cars with from 3-in. to 3¼-in. tread without difficulty, and would have gone fully to 3¼ ins., except that the trucks would not permit the greater weight. The saving on special work, frogs and switches, makes up for any extra cost in making the change. Many of the members to whom he had talked personally are afraid of the granite block, the toothed block, paving brick, and other like things. His company bought forty of the cars used in the World's Fair which had M. C. B. wheels with flanges running from 1 7-16-in. to 1 9-16-in., and 4-in. tread. It was impossible to use the flange, and the wheels were put in a lathe and the flange turned down, but the tread was left alone. They were then put out, and in two trips they had worn the toothed block level with the rail. These cars are now operated as successfully as those with 2-in. or 3-in. tread, and more so, and the saving on special work and the additional bearing on the frogs and switches have amply compensated for any granite blocks which may have been cut off.

Charles S. Kimball, of Washington, thought that if wider wheel treads are adopted, it would often be necessary either to redesign the special work, or to put in new work, or grind the elevated portions back to clear these treads. Moreover, many companies have the grooved rails, which will not admit of a wide flange nor of the deep flange.

Mr. Winsor, of Boston, also thought it undesirable for the association to vote on standards now.

Thomas K. Bell, of Philadelphia, speaking as a manufacturer of special work, said that the average flange to-day on the street railways in this country is very close to ⅞ in. deep. There are possibly only four or five girder rails that are rolled by the mills of the country to-day that are really suitable for a flange any more than ¾ in. in depth. In regard to the guard rails, there is not a guard rail to-day rolled that will accommodate a ⅞-in. flange in a 42-ft. 6-in. radius, with a 7-ft. 6-in. wheel base, without planing the groove. So there is to-day a crying necessity on the part of the street railways to get together on the question of the adoption of a suitable design of rail, and insist on the rolling mills of this country getting them out. That is one of the most urgent things needed. In the T-rail, such as used in Milwaukee, both in the girder T and the low T, that question is set aside. Many other propositions are involved in practical operation. For instance, the New York, New Haven & Hartford Railroad is trying to bring some of its M. C. B. flanges and treads off the steam line into the city work. There is not any of the city work to-day that will stand it, and it is only a question of a few years before the entire track structure would be destroyed by a flange deeper than ⅞ in.; in other words, the best rail in use to-day will only allow a vertical wear of 5-16 inch. In reference to the Trilby types of rails, there are many good features in this section, and there is a very great advantage in the appearance of the surface of the streets when properly paved, but as a matter of fact there is not a Trilby rail rolled to accommodate a ⅞-in. flange outside of the Philadelphia Rapid Transit section in Philadelphia. That is the only rail which will admit of a reasonable number of years of wear before the trams of the rail will begin to cut down. An approach to the ⅞-in. flange, with at least a 3-in. tread, possibly a 4-in. tread, will be the thing that will perhaps solve this problem. Mr. Kimball raised the objection to wider treads being introduced owing to the fact that in many places they had jumped the frogs. In answer to that, the speaker said that there are very few cases of that kind compared to the number of pieces of special work in the country, and he did not consider it a very great difficulty to overcome. He is rigging up machines to go over his entire system for the purpose of grinding the edges of the pavement so as to overcome this difficulty. It is a very inexpensive operation when it is handled in the right way, but it is also a very necessary one in order to prevent the destruction of the wheels.

H. B. Fleming, of Chicago, thought the subject of standardization a very important one, but believed it was wise to move slowly in introducing these standards. About five years ago the Chicago City Railway adopted an M. C. B. truck, and since then it has adhered to that type of truck, making only such changes as were found necessary, due to increase in weight of equipment, so that at the present time it has about a thousand trucks of that type. That helps out greatly in the maintenance end of trucks. In the matter of rails, unfortunately the railway company is not always at liberty to select the type of rail it wants. In many cases, especially in Chicago, the company has to consult with the city authorities, and it is very hard to convince these authorities sometimes that the company has the right design. There are so many things which should be standardized that it is hard to know where to begin. One man will want one line of apparatus standardized and another man will want another. In the matter of painting cars, some roads retain the same colors on the cars that were used in the horse-car days. The Chicago Railway has tried in the last two or three years to paint all of its cars a uniform color. It is also standardizing motors. It has adopted standards in connection with car wiring, and on all new equipments the conduit system of car wiring is used. The company is adopting a standard air brake. The company uses a ⅝-in. flange made necessary by reason of the fact that the city authorities require a very shallow groove in the rail. They insisted at one time that the company should not use a groove of greater depth than 1⅛ in. The present standard is 1¼ ins. It will readily be seen that if there is only 1⅛-in. depth of groove and ⅝-in. flange there is not a great deal of wear on the head of the rail. Recently in Chicago the question of valuation of the street railway properties has arisen, and the engineers who are representing the city in that valuation, have taken the stand that the rail has no value at the time when the flange is running on the bottom of the groove. It is very necessary, as Mr. Bell points out, to get a good, deep, wide groove, allowing the use of larger flanges than has been the custom. The Chicago City Railway tread is 2¼ ins., and the speaker agreed with Mr. Smith, of Kansas City, that it is advisable to make the tread as wide as possible. When they put on the wide tread they found the tread took care of the paving stone and did not give any trouble.

President Adams then appointed the following committee to consider this subject and report back to the association: Paul Winsor, G. J. Smith, W. H. Evans, Thomas K. Bell and John S. Doyle. He then announced the next paper, "Gas Engines," by Paul Winsor, chief engineer motive power and rolling stock Boston Elevated Railway Company, Boston, Mass. Mr. Winsor presented the paper published on page 707.

After reading his paper, Mr. Winsor added that the plant described has been running another month or more since his paper was written, and still running successfully. This plant when at load had 820 kw for the station rating at 700. That is about 18 per cent overload for the hour, but part of that time it was considerably higher. These stations are rated much below the engine rating. The generators are put on more for the normal running of the station, and as they will stand 25 or 50 per cent overload for a short time, these stations are rated very much as a steam station is rated. The company expects to get from that station of maximum demand about 33 per cent above its rating and to run it for 2 or 3 hours; or indefinitely at 20 per cent. This is, of course, a little too high temperature for the generator, but not too much for the short time it is done.

Fred N. Bushnell, of Providence, said he thought it would be of great assistance in the study of the question if Mr. Winsor would enlighten them more on the subject of just what producer gas was and its method of manufacture.

Mr. Winsor said his paper and the thought he had in coming there was to tell what had been done with the gas producer, and not to instruct as to what gas was. A gas engine was nothing but a hot-air engine. They put air and gas into a cylinder and by burning it they heat the contents very hot and get a tremendous expansion and something that would do work. It is nothing but a hot-air engine, and the real question was how to get the gas. There was the natural gas, consisting almost entirely of

hydro-carbon; coal gas having about half the heat value of natural gas, made from the distillation of coal in a closed retort and consisting of hydro-carbon with a considerable portion of free hydrogen; water gas with a heat value of about one-third of that of coal gas and consisting very largely of hydrogen; producer gas of about one-sixth the value of coal gas and consisting of carbon monoxide, which will burn with oxygen from the air; blast furnace gas, which is even lower in heat value than producer gas and of the same general nature. Coal gas made by the distillation of coal in a closed retort contains a large amount of tar and sulphur and must be thoroughly washed before the gas can be used. Some think they can handle hydrogen up to 16 or 17 per cent of the total volume of gas; when they go above that they have trouble. The hydrogen ignites at a much lower temperature than producer gas and they get premature explosions. Hydrogen seldom goes above 15 per cent, and if it gets up there is trouble in back firing. Blast furnace gas is free from hydrogen. It is dirty and the engine will not give so much power, but that is not important. It is easy to handle in a gas engine. Natural gas is a very strong gas and is also easy to handle in a gas engine because it is free from the hydrogen; and producer gas, which is the water gas, or rather the mixed gases, as they are made.

Mr. Hewitt, of Philadelphia, said that the paper was one that interested him especially and showed very encouraging results. Last year, at Philadelphia, a paper was presented on gas engines by Mr. Bibbins and was criticised by Mr. Mailloux, of New York, who thought that only in a few instances would the gas-engine plant show sufficient economy to warrant its extra cost. The steam turbine was quite prominently brought forward at that meeting, and the best results given by the steam turbine in Mr. Winsor's territory were in the Quincy plant and one of the elevated plants which showed an economy of 2.6 to 2.8 lbs. of coal per kw-hour, using the same kind of coal Mr. Winsor is using in this gas plant. If this is correct, Mr. Winsor's paper shows that one could afford to spend about twice as much for a gas plant as a steam plant to get the same final result. That being the case the paper is very favorable indeed for the gas-engine plant. Mr. Hewitt then asked about the regulation.

Mr. Winsor replied that he was using direct-current generators and had no trouble about the regulation.

H. M. Benghler, of Ford, Bacon & Davis, said he had experience last year with a 1400-hp Crosby four-cylinder, 32-in. x 36-in. gas engine at Elmira, N. Y., which operated successfully 60-cycle three-phase apparatus. He had absolutely no trouble at all so far as the parallel operation was concerned. The engines were operated in connection with a steam unit. The four-cylinder engine gave a crank effort that was almost equal to the best steam-engine practice.

E. P. Roberts called attention to the remark made, that as the gas engine would cut the fuel bill one could afford to pay twice as much for the power house. The fuel bill is not the only thing. There are a good many others, as interest on the investment. In reference to operation in parallel, he had occasion during the last two years to examine that quite carefully, to such an extent that at the present time his firm is considering the advisability of putting in a 1500-kw gas engine, 30-cycle railway plant. The present power house is not anywhere near the center of the system, and there is very little water for domestic purposes. The question is, shall that power house be enlarged or another power house of any character be placed in an entirely different location, also whether the company will use 1500-kw or 500-kw units, which shall be used nearly all the time but with the night loads, then the steam engine plant will continue. A question was asked whether it was a fair inference on the paper that if coal cost $3 or more per ton the gas engine plant is preferable. No such general inference can be drawn, because where coal is less than $3 a ton it is sometimes advisable, as in the case of natural gas. In Cleveland, for instance, natural gas from West Virginia costs 30 cents a thousand, and the speaker recently advised the installation of a 275-kw gas engine in Cleveland. Refering again to the paper, Mr. Winsor mentions a load factor of 84.5 per cent, which would indicate that part of the time one engine was operating and part of the time two. It would be desirable to have a load diagram showing when the engines were thrown in and out, and what the operation of each was, because the gas engine will not take the maximum overload as compared with a steam engine.

Mr. Winsor, in reply to several questions, said that the stations described by him are practically sub-stations. The company had two districts. The question was of putting in these plants or adding to the present steam plant. The figures show that the gas plants cost about $80 a kilowatt more than the steam plant. During the month of July the water supply cost $1,071, while the coal cost $550.

Mr. Hewitt asked Mr. Winsor what was the ratio of first cost between these plants and what a condensing plant would have cost in the same locality, assuming that the buildings would be suitable for either plant.

Mr. Winsor replied that these particular plants cost about two-thirds more than a steam plant would cost, based, not on the engine rating but on the station rating. That is, he took the steam plant at $110, and these plants cost between $180 and $190 on the arbitrary rating. He tried to give them a rating that compared with the steam plant.

Mr. Hewitt said the coal in a steam plant is about 50 per cent of the cost of operation, and if it is assumed that the labor cost is the same for gas and steam, and that the sundry costs are about the same, it would not be fair to assume exactly double the cost of the plant. It appeared to the speaker that two-thirds additional cost would practically eat up the saving unless there was some other advantage in the gas plant.

Mr. Yawger, of the Westinghouse Machine Company, wanted to bring up the question of quantity of water used. Mr. Winsor, in his paper, stated his plant uses about 200 lbs. of water. That appeared to the speaker as being a large amount of water for a gas plant, although much, of course, depends on how hot he uses the water and how much heat he takes out of every pound of water.

In reply to a question, Mr. Winsor stated they took from the water about 40 degs. of heat.

Mr. Yawger repeated that 200 lbs. seemed a good deal of water, but if an estimate was made of the amount of water that would actually be wasted in a cooling tower in order to take out, say, 40 or 50 degs. of heat, the figures would show something like 7 or 8 lbs. of water actually wasted or evaporated in a cooling tower, and having only 200 lbs. per kilowatt to handle it would make the pipes and the cooling tower itself quite a small piece of apparatus per kilowatt. The whole subject seems to line up in this way: That gas engines are at the present time to be looked upon as desirable in special locations, where coal is high, where water is scarce, and where other conditions like the saving in copper, etc., enter in. Of course, the cost per horse-power of the gas engine is bound to be a good deal more than the cost of a steam engine, unless gas engines can be made a great deal lighter per horse-power than now. The weight in a large engine will run about 500 lbs. per horse-power, and the price of coal seems to be about the same as it has been, and the price of labor is not getting cheaper, so that it is hard to see where there is going to be any improvement unless it is in a change in design.

The next paper was "Underground Cables," by H. G. Stott. This paper is published on page 705.

W. Boardman Reed, of New York, thought emphasis might be laid on one or two points touched upon in Mr. Stott's paper. First, the character of the ducts, which are rough inside and have little points projecting. These cut the lead sheath and render the paper valueless, if the duct is wet or damp. In the second place, the speaker thought that they did not use sufficient care in laying ducts, especially where laid on horizontal or vertical curves. The first cables for high potential work were laid in New York about 1886, and these were laid without lead sheaths, and were operated for about fourteen years without any trouble. That was before the days of the automobile, when rubber was much cheaper than now and when labor was considerably less, and they could afford to use a good quality of rubber. He thought there was a demand for the use of better insulation in some places, and rubber-covered cable, if engineers felt they could afford it, would stand up in the damp places.

Mr. Winsor spoke of trouble with return currents on lead sheaths. They had considerable trouble with cables burning out, the heavy return currents burning the leads out at bonds where they touched and had a good ground. That was so serious that in almost all cases now the lead sheath is cut out for an inch or two off each side where it enters. Mr. Stott does the same thing by insulating the lead sheathing on the racks.

Mr. Latey explained the use of the negative return in the Manhattan installation. They had a large heavy structure, and followed the usual practice of using that structure for return with about the usual results. When they came to the subway they had no structure, and about the time they got ready to lay out the negative return circuits, they had to give up one of the rails for the signal system, which left one 100-lb. rail for a return circuit for about 2½ miles of structure. They figured all kinds of schemes for putting in copper, and incidentally estimated the output of the copper market. It did not look as though there would

be much copper left for anybody else by the time they got the return dropped down to reasonable limits. The only thing they could do was to put in insulated negative cables which would in a way get around the restrictions imposed, and they put in insulated negatives, fitting in in four places between sub-stations; that is, having four points of collecting the return current and carrying that insulated cable back to the sub-station. That gives a potential difference of perhaps 60 or 70 volts between points on the return rail and the sub-station bus, but only about 5 or 6 volts difference of potential between the return rails and the water pipes in the immediate vicinity. On the Manhattan division, even with heavy structures, the telephone company got after the railway on the question of return circuits. The company used bonds near every sub-station or special point of feed. Near the subway it had but one place where it wanted a bond, and the railway company could not understand why this was required until a short circuit was developed shortly after, burning off a number of wires at the sub-station. It was found that the telephone people had a sub-station negative bus which explained that particular situation. On the Manhattan division they had 3½-in. ducts carefully inspected and laid by the Conduit Company, of New York. On the subway division they had 3¼-in. four-way ducts, which were not particularly well inspected, but they had practically no trouble except that which was caused by the lead sheathing being cut in the duct. Nearly all trouble was due to bad joining or bad bending. They had a few cases of burnouts in ducts, that might have been caused by rough ducts, such as refered to by the previous speaker.

Charles S. Kimball, of Washington, said they had considerable trouble in Washington with the sheath cables being grounded, not in the manholes, but between the manholes. They have traced this and find it to be a fact that the difficulty is caused by the cement-lined iron ducts. They find that the cement becomes brittle and cracks and separates from the iron. Of course that causes the ground. They are doing away with these iron ducts as fast as circumstances will permit. The company has been laying a considerable amount of new ducts recently, and uses a scraper made of four steel blades with which every piece of terra cotta and tile duct is scraped. That eliminates the rough points in the ducts which are likely to injure the lead sheeting in the cable.

Mr. Winsor asked if any of the members are making insulation tests or break-down tests on their cables, and wanted to know if any one was using a higher voltage than the working voltage to test the cables periodically.

Mr. Latey said about the only tests they make on the direct-current table is the voltmeter insulation test. They are getting the insulation resistance by means of a 700-volt voltmeter. The high potential cables are not tested periodically. They have to test them occasionally when changing connections and in case of break-downs, but that is about the only test that these cables are getting. In the case of an 11,000-volt cable, they gave it a 19,000-volt break-down test for about five minutes, which is very much below the contract test.

Mr. Winsor said the Boston Elevated buys its cable on a guarantee that the insulation resistance shall not go below a certain figure in a certain number of years. They test the cable every two weeks, and follow the curve of the insulation test very carefully. They find if the insulation goes down it is apt to go down rapidly, and the curve will flatten out. Their experience is that if a cable falls from 200 megohms per mile to 25, and keeps falling steadily, it is sure to keep on falling.

The meeting then adjourned until 2:30 o'clock.

TUESDAY AFTERNOON SESSION

President Adams called the meeting to order at 2:30 o'clock, and announced the first paper of the afternoon session would be that of "Relative Economy of Turbines and Engines at Various Percentages of Rating," by Walter Goodenough, engineering department, Stone & Webster, Boston, Mass. Mr. Goodenough unfortunately could not attend the convention, and the secretary read the paper. This paper will be found on page 712.

Mr. Winsor thought Mr. Goodenough's paper was more particularly interesting to the financial end of the business, and the constructing and designing engineer. He did not agree with the author that it affects the operation at all. If the engineer has a given plant, and interest charges go on in spite of him, the only thing he can do is to lower the cost of operation. He should not consider the question of interest charges after he once has the plant, but should run the plant at the lowest cost of operation. When he comes to the point of possible increase of plant, it is up to the designing engineer, and he should take the interest charges into consideration, or consider whether or not he should run his present plant at heavy overloads or low efficiencies, or whether he should add to it and run up the interest charges. The operating engineer should not take into account the question of fixed charges.

President Adams then appointed as the committee on nominations the following: W. B. Reed, New York; D. F. Carver, Rochester; H. B. Fleming, Chicago; M. O'Brien, St. Louis, and Alfred Green, of New York.

The next paper was entitled "Economy in Car Equipment, Weights and Schedules," by E. H. Anderson, Schenectady, N. Y. This paper will be found on page 715.

Before opening the discussion on this paper President Adams announced that Mr. Mower had intimated that this year will be his last year as secretary. Mr. Mower has taken upon himself the duties of general manager of the road, and these duties will not permit him to give the necessary attention to the affairs of the association. Mr. Adams wanted to say to Mr. Mower, for the association, that his efforts in the past have been of great value to the association, and the result of his work in the old association when it was a question of getting in new members and similar work put the association on the basis it was in when it came to the point of reorganization. He wanted to thank Mr. Mower in the name of the association for his efforts in the past.

President Adams then relinquished the chair to Vice-President Simmons.

N. W. Storer, of the Westinghouse Company, said that, in his opinion, one of the greatest features in selecting motor equipments for successful operation is to get the right reduction for the motor. There have been thousands of dollars wasted and thousands of equipments given a very bad reputation simply because of the selection of a bad gear ratio. The motors may be geared for entirely too high a speed or too low a speed, due to the fact that a proper study of the conditions was not given before the gear ratio was selected. There could be numerous cases of that kind pointed out.

For illustration, the speaker assumed a case where a motor was selected that was geared for a speed of 30 miles an hour, when the service requirements were such as to need only a maximum speed of 15 or 20 miles an hour. That motor is going to be run at a low voltage practically all the time. The speaker had in mind a road where the motors are operated at an average voltage of about 275 volts while the line voltage will average practically double. That means the motors have their capacity cut in two, and they are operating at about half the horse-power capacity which they would have if they were operated for longer periods on the high voltage. The motor is designed for 550 volts, and to get the capacity out of it, it is necessary to have that voltage as large a part of the time as possible. That is where the high-speed gear reduction will come in. If the motor is operated at too low a reduction, that is to say, at too low a speed, it will be necessary to force the motors, and in braking a large part of the power in the motor is lost in the brake-shoes. This not only wears out the brake-shoes, but uses up the coal pile at the same time. That is where the slow-speed gear gets in its bad work. The lower the speed gear the easier, as a general thing, is it for the motor to get over the ground, and the lower the heating will be. There is a great tendency on the part of people who go into interurban work to adopt gear ratios which are really beyond the requirements. They want to reach a maximum speed of 45 or 50 miles an hour, while the track conditions may not be such as to make it possible to use that excessive speed for any considerable part of the time. They sacrifice a great deal in the capacity of the motors to gain a little in the speed on a small part of the line. That is a mistake, but it would not be so bad if they could get sufficient motor capacity at the same time, but they select a quadruple equipment of 75 hp for a 35-ton car and gear the cars for a very high speed. The result is that the motors are badly overloaded. The cars might make the scheduled speed if they were properly geared for it, but the point is very well shown in the curves, namely, the effect of the high schedule speed on the capacity of the motors which are required. There is one point brought out in the paper in regard to the number of motors in an equipment which should be further dwelt upon. It was stated quite correctly that a great deal of trouble is experienced from the wheels of the car slipping where the weight is not all on the driving wheels. That is very apt to be the case, and it compels the companies to adopt four

motor equipments where two motor equipments would do just as well, if they did not have this slipping. A great deal of trouble is due to the fact that the hand controller is not properly operated. The motorman may throw the controller on too fast, giving the motors very heavy rushes of current. That will momentarily give a very high torque, and start the wheels to slipping. The speaker believed the adoption of the multiple-unit control equipment for street cars with purely automatic acceleration will go a long way toward avoiding that trouble. With multiple-unit control the acceleration is practically out of the hands of the motorman; it depends entirely on the adjustment which the control is given before the car leaves the depot. If it is adjusted for 150 lbs. per ton acceleration, that is what it is going to do. For instance, with a double-truck car, at least 60 per cent of the entire weight is on the driving truck wheels. That should give acceleration to the car of 150 lbs. per ton with about 12.5 per cent adhesion. It is possible in most cases, anyway with the use of a little sand, to obtain 12.5 per cent adhesion on the rails even if they are very slimy, and that will give a very good acceleration. A mile and a half per hour per second is to be commended for practically all city work, although it is exceeded in many places, and is much less than that in others. The fact remains, however, that the acceleration will always be at a predetermined speed. That is an advantage which must not be overlooked, and the importance of having a certain rate of acceleration is plainly illustrated in the curves accompanying the paper. Mr. Storer then pointed out some of the additional advantages of multiple-unit control for city cars. These may be summed up as follows:

While it may not be directly under discussion on this paper, at the same time he thought it would not be out of place to show the economies which can be secured in other directions by the use of this same multiple-unit control for street cars. In many cities one will hear the cry "There are not enough cars." The trouble is in the crowded condition of the streets. It is impossible to force more cars through the streets, as they are so crowded that, under the present conditions of operating one car at a time, there is very inefficient operation. It seemed to him that by coupling two or three cars, a very large increase in the number operated may be easily secured. He was glad to note from the discussion on the preceding day how many people were thinking of the multiple-unit control equipment for street cars. This is entirely in the right direction. The use of it in the crowded streets will be of benefit. Suppose three cars are coupled in a train, one avoids two spaces between the cars. These spaces are entirely useless, and if the cars are running close together, it will be found that wagons creep in and people are crossing the street so there is much interference with the traffic all the time, and the single cars can go along only in a succession of jogs. If there are three cars in a train, two spaces will be avoided, and the time spent at crossings and in clearing blockades very much reduced. At crossings only one signal from the corner man will take the three cars across the street, otherwise three signals must be given, and there would be greater interruption of the service. About the only difficulty he could see in such operation is in the coupling of the cars, but that, he thought, could be obviated. Multiple-unit control will also partially dispose of the last paragraph of the paper which states: "The above illustrates strongly that the largest car which can be run, and the proper frequency of cars maintained will give the least cost per seat or passenger-mile." That is on the basis of having the single-car equipments. If multiple-unit control is used, fixed charges on a large train are cut down to a very great extent, and the smaller equipments can be employed to much better advantage.

Mr. Priest said that Mr. Anderson had very clearly pointed out some of the controlling features in the selection of equipment. He thought too much emphasis could not be placed on the careful consideration of the service requirements before choosing the size or type of motor. He believed it would be greatly to the advantage of both consumer and manufacturer if they would get together more in the consideration of this problem. If the user would indicate very clearly to the manufacturer just what his service conditions are, going into considerable detail, giving the weight of cars, number of stops, and general character of the service, he was sure that the manufacturer could be of great assistance in choosing the proper equipment. Referring to Mr. Storer's point about gear ratio, he quite agreed with him that very often an improper gear ratio is selected, and usually it is too high. This not only results in greater consumption of energy for a given schedule, but also in abuse of the equipment. While perhaps too broad a statement to make, he thought that, generally speaking, it may be said that the lowest speed equipment which will perform the service is usually the best one to select. Therefore, when a street railway man calls for a speed of 45, 50 and 60 miles an hour, he should very carefully consider the results of using such a high-speed equipment. In the great majority of incidents he believed a low-speed equipment would fulfil all the requirements and do it with much greater economy.

Mr. Olds fully agreed with the proposition as placed before the meeting by the speakers and said it bore out his views as to the maximum speed that so many operating men require the rolling stock men to have for the gear ratios. They often say that they wish to make 40, 50 or 60 miles per hour, when the facts are, they do not average 25 miles per hour. As a consequence, the motors are overworked and very often burned out. In his own case where some motors were arranged for 45 miles per hour, the gear ratio was changed to bring the speed down to about 35 miles per hour. It was found that the consumption of energy, operating on the same schedule and making the same speed with the same cars was very much reduced. The maintenance charge also was reduced to a very considerable amount. He was pleased to note how fully Mr. Anderson had brought out these matters, and as Mr. Priest had said, it was very important that the operators should get close to the manufacturers. It would save the former money, which is the point they were after, to get good reliable service that shall be attractive to the public and bring the largest returns to the railway companies.

Mr. Rolston referred to some experiences he had in the past six months with different gear ratios used on the G. E. 73-motor. In the one case with the gear ratio of 1.7 they got a maximum current of 950 amps., while in the other case with a gear ratio of 2.3, same motor and same weight of car, four-motor equipment, about a 40-ton car, they had a maximum of 625 amps. The rise in temperature, maintaining the same schedule and practically the same stops—observation taken on similar days under similar conditions—was 30 degs. more in the case of the high-geared motor. The current consumption as taken by a recording wattmeter was very little in excess in the case of a high-geared ratio. The fact was, that the maximum jerks in starting seemed to be responsible for a large amount of the heating, but on two of the equipments which were reduced, the gear ratio was changed again to 2.6 and gave still better results. Taking the average, as a whole, the business could be handled with the gear ratio at 2.3 with considerable less effected maximum pull at the power house than it could in the other case. The only instance he had in mind where the higher gear ratio might be adopted to good advantage was in the case of limited service, with very few stops of 8 or 10 miles apart. Then the higher gear ratio might come in to fairly good advantage and prove profitable, but where the stops are frequent, averaging 1 mile or 1½ miles apart on interurban service, the high-gear ratio would be a detriment. Another trouble was the failure of fields on this particular motor, G. E. 73. They had on an average defective fields one to three, in favor of the lower gear. It seemed as if those on the higher gear were heated up to a higher temperature and more liable to flashing and causing trouble of that kind, and it was not uncommon to pull out burned-out field once in every two weeks on these cars. The previous management had supplied the road with gears to change them over to the high ratio, but after making a careful investigation they decided it was better to go back to the lower ratio.

Mr. Storer said there was another point which might be mentioned in connection with the question of gear ratio. It is frequently deemed advisable by the management of a large system to select one standard gear for all classes of service. In view of the developments which have come up and the necessity of making changes, was it not best to capitalize that standardization work and see how much it is worth to the company; would it not be better to keep one standard motor and gear it for several different classes of service if necessary on the same system, gear it properly, and get the benefit of the lower power consumption, and the longer life of the motor, but have it so that one will not have interchangeable equipment, so to speak. He thought that point should be capitalized and see how much it was worth.

Upon motion of W. H. McAloney the consideration of the question box was deferred until the next session, Wednesday afternoon at 2 o'clock.

WEDNESDAY SESSIONS

The Wednesday morning session of the Engineering association was held jointly with the American association, and is reported on page 766 of this issue.

At the Wednesday afternoon session the Question Box was received without discussion, after which the committee on resolutions presented resolutions thanking the local and interurban

roads of Columbus for courtesies extended; expressing the appreciation of the association for the work accomplished by President Ely, of the American association; thanks to H. Wallerstedt, of the standardization committee and to President Adams.

The committee on nominations next made its report, and the following officers were elected for the ensuing year: President, H. H. Adams, of Baltimore; first vice-president, F. G. Simmons, of Milwaukee; second vice-president, J. S. Doyle, of New York City; third vice-president, Paul Winsor, of Boston; secretary and treasurer, Walter Mower. Executive committee, the officers and F. H. Lincoln, of Philadelphia; F. N. Bushnell, of Providence; W. T. Dougan, of New York City, and H. B. Fleming, of Chicago. The convention then adjourned.

ANNUAL ADDRESS OF THE PRESIDENT OF THE AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION

DELIVERED BY S. L. RHOADES
At the Columbus Convention of the Association on Monday, Oct. 15, 1906.

The Claim Agents' Association was particularly favored by the executive committee of the American association when the latter selected Columbus as the convention city. Fortunately, our worthy secretary is a resident here, and, as I am reliably informed, is familiar with the ways and means to insure the most exclusive claim agent a profitable and enjoyable time. I am quite sure that none of us will fail to take advantage of the invitation extended.

It was early decided that this season's convention should be held in the Middle West and Columbus was selected only after several other cities had been considered because it offered the best accommodations for the majority interested. Incidentally, we are afforded an opportunity to examine the methods and management of the accident department of this city's railway, which, I believe, is maintained at a very low percentage of the gross receipts.

Although this is the second annual convention of our association, it is the first since the reorganization; and I am pleased to say that we are progressing, and the fear entertained by some of us, that in organization we might lose our identity or be restricted in our work, was without foundation; on the contrary, there has been perfect harmony and co-operation. The officials of the parent organization have promptly granted every reasonable request and shown their desire to assist us wherever possible. We acknowledge our indebtedness to the executive officers of that association for their assistance in perfecting our organization and particularly to Professor Swenson for his personal attention to many of the details. With this co-operation we were able to formulate and adopt a constitution and by-laws consistent with those of the other organizations and satisfactory to the executive committee who had the matter in charge. It has also been our opportunity and very great pleasure to assist the parent organization, by promptly answering all communications referred to us by its secretary, regarding claim departments, and these queries came not only from America, but from Europe, Australia and the Philippines, thereby showing that we, as a Claim Agents' Association, are recognized wherever street railways are operated.

I venture to predict from the attendance that this will be a unique and successful convention. During the past year your executive committee, following the suggestion of Vice-President O'Connor, has organized and put into operation a Question Box, which has proved a success beyond our expectations. In the questions and answers valuable information is contained, applicable to claim departments of all classes of electric railways.

We have also on exhibition, at the suggestion of Mr. Renaud, of New Orleans, copies of the blank forms of reports, etc., used by various companies. By a close examination of these printed forms new ideas may be obtained, and I trust that at the proper time we will have a free discussion concerning their merits. While it seems impracticable that any standard set of forms could be universally adopted, I would suggest the advisability of appointing a committee to consider the matter, together with the question of keeping statistics. Of one thing I am convinced, that as the cost of the accident department increases, our superior officers will require more definite and particular information concerning expenditures. We should therefor aim to be in a position to furnish an answer to such questions, and, if it is possible, to arrange a standard system of statistics and accounts, which by comparison might become of universal interest and value.

Each year our street railway companies are compelled to meet a larger and more unscrupulous class of persons who prey upon their treasuries. This practice is reaching such proportions that something should be done to check it. While it is too broad a subject to be discussed here, I wish to suggest the advisability of appointing a committee to consider the problem and devise some practicable method of treating it. There are other organizations now considering the question, and while it may not ultimately be a matter for the Claim Agents' Association to deal with, it seems that if we could suggest to the American association some plausible plan, it might be willing to consider the matter. While I am speaking on the subject of committees, it has occurred to me that if we had something like an "employment" committee, it would be an advantage. For example, during the past year I have been asked a dozen times if I could suggest the name of an experienced and capable man to take charge of accident departments. If I were to give particular attention to this matter, would it not accrue to our benefit? A very capable agent may, for one of many reasons, lose or resign his position and be looking for another. I recall a half dozen instances where this has occurred through consolidations, changes of management, etc. If these facts were in the possession of such a committee, our association would be able not only to answer the question but supply the man, who being both experienced and competent, would strengthen us.

It is with deep regret and a feeling of sincere sorrow that I announce the death of an active member of our association, Mr. Feeney, of New Jersey. Mr. Feeney attended the convention last year and took an active part in the discussions.

The papers to be presented at this convention are particularly interesting and valuable, a credit to the association and to the speakers. The association invites a free discussion on both the papers and the Question Box, so that we will all derive interest and benefit therefrom. In conclusion, I wish to thank the members of the executive committee and of the association for their loyalty and co-operation, and I sincerely trust that to all fellow-workers present, the convention will prove most successful.

THE NEW OFFICERS OF THE ALLIED ASSOCIATIONS

At the Columbus convention the various associations elected officers as follows:

Engineering Association.—President, H. H. Adams, superintendent of shops United Railways & Electric Company, Baltimore; first vice-president, F. G. Simmons, engineer maintenance of way Milwaukee Electric Railway & Light Company; second vice-president, J. S. Doyle, superintendent car equipment Interborough Rapid Transit Company, New York; secretary and treasurer, Walter Mower, general manager Southwestern Traction Company, London, Canada. Executive Committee—The officers and F. H. Lincoln, assistant general manager Philadelphia Rapid Transit Company; F. N. Bushnell, chief engineer the Rhode Island Company, Providence, R. I.; W. T. Dougan, engineer maintenance of way New York City Railway; H. B. Fleming, chief engineer Chicago City Railway.

Accountants' Association.—President, C. L. S. Tingley, of Philadelphia; first vice-president, J. H. Neal, of Boston; second vice-president, E. F. Bryant, of Bridgeport, Conn.; third vice-president, C. L. Wight, of Des Moines; secretary and treasurer, Elmer M. White, of Birmingham, Ala. Executive committee, the officers and W. B. Brockway, of New York; H. T. Bunn, of Knoxville, Tenn.; A. Stuart Pratt, of Boston,.Mass.; H. S. Swift, of Toledo.

Claim Agents' Association.—President, S. L. Rhoades, of the Philadelphia Rapid Transit Company, re-elected; first vice-president, Henry G. Bradley, of the Chicago Union Traction Company; second vice-president, A. J. Farrell, of the International Railway Company, Buffalo, N. Y.; third vice-president, W. F. Weh, of the Cleveland Electric Railway Company, and secretary and treasurer, B. B. Davis, of the Columbus Railway & Light Company, re-elected. Executive Committee—The officers and Charles B. Hardin, of St. Louis, Mo.; Peter C. Nickel, of New York; F W. Johnson, of the Connecticut Railway & Lighting Company, Bridgeport, Conn., and E. C. Carpenter, Anderson, Ind.

Manufacturers' Association.—Five members of the executive committee were elected for three years each, namely, H. C. Evans, of the Lorain Steel Company; C. C. Pierce, of the General Electric Company; A. H. Sisson, of the St. Louis Car Company; K. D. Hequembourg, of the Franklin Car Heating Company, and W. M. McFarland, of the Westinghouse Electric & Manufacturing Company. Thomas Nute, of the St. Louis Car Wheel Company, and E. H. Baker, of the Galena Signal Oil Company, succeed themselves. Hugh N. Wilson was also elected to succeed himself for a two-year term.

PAPERS AND REPORTS PRESENTED AT THE COLUMBUS CONVENTION OF THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION

ELEVATED RAILWAYS AND THEIR BEARING ON HEAVY ELECTRIC TRACTION

BY H. M. BRINCKERHOFF.
Electrical Associate of William Barclay Parsons, Consulting Engineer, New York City

When entering upon a new field of activity, or upon a line of work exceeding in magnitude anything heretofore attempted, one naturally looks about in an effort to ascertain what has been done in similar undertakings that may in one way or another supply some useful lesson or be a guide in shaping the new development.

The demand for greater terminal facilities for the steam railroads in our great cities and the necessity for doing away with the smoke incident to steam locomotive operation in the tunnel approaches to such terminii has practically forced a peculiar limited application of "heavy electric traction" in the steam railway field.

The new and varied problems that have arisen have engaged the attention and received the most careful study from the foremost electrical engineers in the country, together with the steam railway officials whose systems are involved. In the course of this work much has been said and written upon this and related subjects, so that the questions involved have become more or less familiar to the reading railway man, whether steam or electric. In an effort to present to you something that possibly may have been overlooked and yet be of some present interest in connection with the "heavy traction problem," I will point out some features that have been impressed upon me in elevated electric railway operation which may have a bearing on the subject under discussion.

I think it is a safe statement to make that the elevated railways present the best example of systems approaching heavy electric traction conditions, that have been operated for a sufficient period and on a large enough scale to give us good operating data, and show the results of standardization and thoroughly systematized management.

The interurban railways have made wonderful strides in the past few years, but the number of car equipments employed and the periods they have been in service have not given them the severe trying-out process of continued heavy use such as has been the case with the elevated railways.

Commencing with the Intramural Railway at the Columbian Exposition at Chicago in 1893, the Metropolitan West Side Elevated in 1895, followed by the Lake Street, the South Side Elevated, and the Northwestern elevated, all in Chicago, and the Manhattan and Brooklyn Elevated in New York City, and the Boston Elevated in Boston, we follow through a period of thirteen years of successful practical daily performance of very severe service.

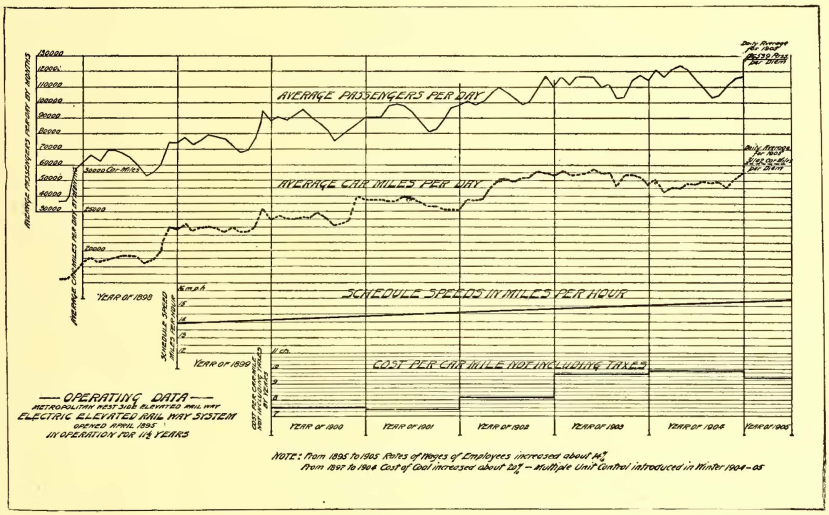


FIG. 1.—DATA SHEET SHOWING PASSENGERS, CAR-MILES, SCHEDULE SPEED AND COSTS

These elevated railway systems of Chicago, New York, Brooklyn and Boston, including the Interborough subway service, operated in round figures 170,000,000 car-miles, carried 685,000,000 passengers, and made gross earnings of about $34,300,000 during the year 1905.

This was accomplished with electrical equipments. The South Side and Oak Park lines in Chicago, and the Manhattan and Brooklyn lines in New York and Brooklyn, originally were run with steam engines, which, therefore, give us a basis upon which to draw some interesting comparisons. Through the courtesy of the managers of these properties I am able to give you the following data, placing the roads in the order in which they were converted from steam to electric operation.

OAK PARK & CHICAGO ELEVATED RAILROAD.

	Steam Year of 1895.	Electric Year of 1904.	Increase Per Cent.
Passenger cars	100	123 (includes motors)	
Locomotives	35	42 (motor cars)	
Total car miles	2,721,965	4,550,799	
Total passengers hauled	9,936,450	16,005,328	
Passengers per car mile	3.65	3.52 (decrease)	3.6
Passengers per car per annum	99,364	130,124	23.
Cost per mile	$0.1174	$0.1078 (decrease)	8.2
Schedule speed, m. p. h.	12.5	15 m. p. h.	22.

Period of electric operation, eight years.

SOUTH SIDE ELEVATED RAILROAD (CHICAGO).

	Steam Year of 1894.	Electric Year of 1905.	Increase Per Cent.
Passenger cars	110	254	
Locomotives	31	196 (all motors)	
Total car miles	5,182,598	8,230,415	
Total passengers hauled	13,587,791	32,959,752	
Passengers per car mile	2.62	4.00	52.6
Passengers per car mile per annum	123,525	129,762	5.
Cost per car mile	$0.106	$0.089 (decrease)	16.
Schedule speed, m. p. h.	13.08	14.95 m. p. h.	14.3

Period of electric operation, seven years.

BROOKLYN RAPID TRANSIT (ELEVATED DIVISION, BROOKLYN).

	Steam Year of 1898.	Electric Year of 1905.	Increase Per Cent
Passenger cars	430	1,002 (includes motors)	
Locomotives	139	558 (motor cars)	
Total train miles	5,158,365	22,407,331 (car miles)	
Total passengers hauled	44,170,810	122,166,540	
Passengers per car mile	.....	5.2	
Passengers per car per annum	102,723	121,922	18.7
Schedule speeds, m. p. h.	11.5	15.8 m. p. h.	37.
Cost per train mile	$0.384	Cost per car mile	

Period of electriojerc ation, six years.

For later references and to complete the list the following statistics are added for the roads originally equipped electrically:

METROPOLITAN WEST SIDE ELEVATED RAILWAY (CHICAGO, YEAR OF 1905).

Passenger cars	420
Motor cars	158
Total car miles	11,352,358
Passengers hauled	46,186,753
Schedule speed, m. p. h.	15.4
Cost per car mile	$0.0931

Period of operation, ten years

In all the cases "cost per car-mile" given is the total operating expenses for the road, not including taxes divided by the total car-miles.

An examination of these figures for steam and electric service shows in every case a decreased cost per mile, an increase in schedule speeds, and a very large increase in traffic. In considering the decrease in cost per mile with electric over steam operation in the above comparisons, the fact of the increased speed must be especially noted as the higher rate of acceleration

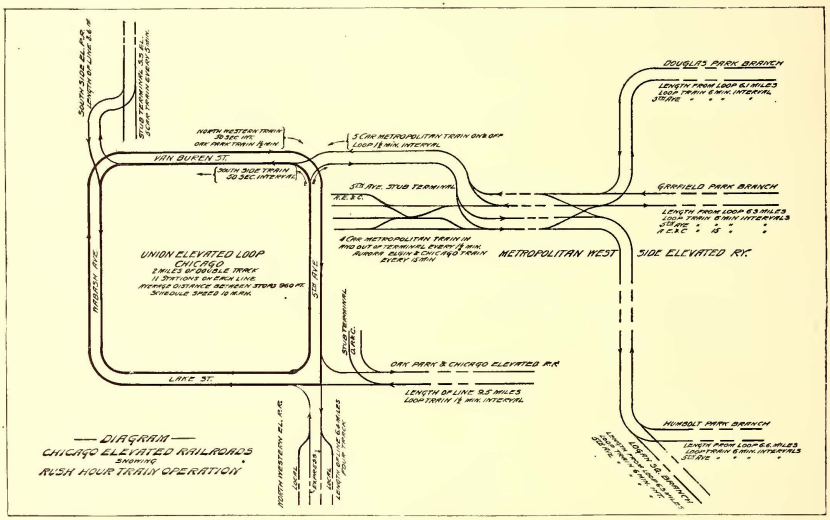


FIG. 2.—PLAN OF UNION ELEVATED RAILWAY LOOP IN CHICAGO

Under steam operation this company's records were kept in train-miles, and no estimate of cars per train at this date is reliable. Electric operation data is kept per car mile, but the costs are so involved between the street car and elevated systems as to make an exact figure impossible to reach, the power for both systems being generated and distributed without means of separate measurement. Both kinds of equipments being operated on surface and elevated tracks, also makes the division of costs purely arbitrary. The general indications are, however, that the cost per car-mile is slightly less with electric than with steam, at the same time giving an increased schedule speed.

MANHATTAN ELEVATED RAILROAD (NEW YORK).

	Steam Year of 1901.	Electric Year of 1904.	Increase Per Cent.
Passenger cars	1,122	1,356 (includes motors)	
Locomotives	334	833 (motors)	
Total car miles	43,860,158	61,743,000	40.
Passengers hauled	190,045,741	286,634,000	50.
Passengers per car mile	4.34	4.65	7.15
Passengers per car per annum	169,381	211,382	24.8
Cost per car mile	$0.1198	$0.095 (decrease)	20.4
Schedule speed, m. p. h.	10.1	15 m. p. h.	48.5

Period of electric operation, three years.

MANHATTAN—INTERBOROUGH (1905).

Including subway service.

Passenger cars	2,348
Motor cars	1,322
Total car miles	79,950,791
Passengers hauled	339,104,820

Schedule speeds: Elevated, 15 m. p. h.; subway local, 15 m. p. h.; express, 25 m. p. h.
Period of operation (subway), one year.

Even more marked is the increase on the Manhattan Elevated, where the actual running speed was 10.1 m. p. h. under steam, and which has been raised to 15 m. p. h. with electric operation. An increase in speed of 48.5 per cent. With a cost per car-mile of $.095, the proportion chargeable to power will range in this class of service from $.019 to $.024, a little less than 25 per cent of the total. By "cost of power" is meant the total operating expenses incurred in producing and delivering current to the car. The maintenance of the motor equipment and kindred items will also quickly show the effects of changes in schedule speed, and must be considered in these comparisons.

For these reasons had the speed not been increased above the steam schedules, when the change in motive power was made, the electrical equipment would have shown in some cases from 25 to 30 per cent decrease, other conditions remaining stationary.

As the objection is sometimes made that the figures we are considering are derived from electric apparatus in use but a few years, and are being compared with old steam apparatus figures, let us examine the record of the Metropolitan West Side Elevated Railway, of Chicago, in operation electrically now for eleven and a half years, which stands, therefore, on a fairly

necessary to give the higher schedule speeds means a great increase in power consumption, so that the decreased cost shown on the face of the figures does not at all represent the true relative economy. As an example, the South Side Elevated Railroad, of Chicago, increased its schedule speed from 13.08 m. p. h. to 14.95 m. p. h. This represents an increase in power required per car-mile of fully 30 per cent.

equal footing with the other steam elevated equipments.

On the data sheet Fig. 1, is shown: (1) The curve giving the average passengers per day, plotted by months, except for the year 1905, which is shown for brevity, by the daily average for the year. (2) The average car-miles per day similarly plotted. (3) The schedule speed in miles per hour. This is represented by a sloping line from 13.9 m. p. h. in 1898 to 15.4 m. p. h. in 1905. This method of representation was resorted to for simplicity, as the road having four branches, which from time to time were extended, the schedules were changed so frequently that the facts could not be intelligibly shown in a single curve. The main fact, however, that the schedule speed of 13.9 m. p. h. early in the operation of the road has been raised by various intermediate steps to 15.4 is indicated. This does not include the speed on the Union Loop, which is 10 m. p. h. and is considered as a downtown terminal for the elevated roads. (4) The average cost per car-mile as given by years.

It will be seen that this, commencing in 1900, at .0751, increases gradually to .0971 in 1904, and decreases to .0931 in 1905, with the introduction of the multiple-unit system. This change to multiple control involved the purchase of only fifty-five new motor equipments, raising the number of motor cars to 158. The service is still locomotive in type during sixteen of the twenty-four hours, two motor cars per train only being in use during the heavier periods of travel, the average cars per train throughout the year being less than three. It will be noticed that the rates per hour or per day paid to employees increased about 14 ped cent, and the price of coal about 20 per cent in the same period.

Here, then, is an electric system that has been in operation ten years, upon which the motors, rolling stock, track system, etc., have developed a practically constant maintenance charge. That this road, making a schedule speed of over 15 miles per hour, should now be showing, in its tenth year of operation, $0.0931 per car-mile is a very reasonable argument for the economy and durability of an electrically equipped system.

Referring again to the comparative figures on the electric railroads that have changed their form of motive power, we find increases in earnings per mile, per car per annum, etc., all of which simply point to the greater earning capacity of the electric car unit.

This greater earning capacity is shown to be due in the systems we are considering to higher schedule speed along the line and the shorter intervals between train units, made possible at junctions and terminals. As examples of these features take the following:

The New York terminal of the Brooklyn Bridge depended originally upon steam locomotives for its operation. Cars were hauled by cable across the bridge and then switched at each end by steam locomotives. The service proved inadequate, and upon electric motors being installed under the bridge cars the locomotive system was done away with, and a remodeling of the track system was made possible, which resulted in doubling the capacity in cars per hour.

On the Manhattan elevated system all of the Ninth Avenue trains and the Sixth Avenue trains which run north of Fifty-Ninth Street, pass through the junction at Ninth Avenue and Fifty-Third Street. These tracks, two local and one express, lie north and south on Ninth Avenue, and two turn east in Fifty-Third Street to join the Sixth Avenue line. The capacity of this crossing therefore controlled the amount of service it was possible to give on the west half of the Manhattan system.

The northbound tracks on Ninth Avenue, approaching from the south, have an ascending grade of 107 ft. to the mile. Through this junction steam trains of five cars were scheduled to operate at an interval of from 55 seconds to 1 minute and 10 seconds during the rush hours, but blocks were so frequent on account of locomotives stalling on the up-grade in the evening rush as to make the service very unreliable. The length of interval was largely controlled by the necessity of holding the train back almost at Fifty-First Street until the route was clear, in order that the steam engine migh be sure of getting up the grade. With electric equipment trains of seven cars run right up to the target at the crossing, and stop with impunity on the grade, the regular rush hour operation now requiring a train movement every 33 seconds as a minimum, which is accomplished with regularity and precision, and blockades are things of the past.

On the two-track stub terminal at the City Hall station, Manhattan elevated trains now operate on a 1-minute and 40-second interval.

In general terms the irregularity at junction points, congestion at terminals, and the limitations in speed of the locomotives on the Manhattan Elevated had caused the system to reach its maximum usefulness, the largest regular business day's traffic being 852,000 passengers, and the total traffic for the last years of steam operation actually showing a continual decrease. With the introduction of electric service, the maximum traffic, without adding a foot of track, jumped to 1,076,000 passengers as the largest regular day's business, an increase upon the best showing of steam of over 26 per cent.

You will readily note the large increase on the other systems, which results, however, are complicated in some cases by reason of increased trackage having been put in operation, and therefore not making so striking a comparison as the Manhattan Elevated in New York. Enough has been shown, however, to warrant the claim for a greatly increased capacity by electrically equipping these systems.

Let me dwell a moment longer on the frequency of service by showing what is the daily routine on the Union Elevated Loop in Chicago.

Referring to the diagram, you will see that the "Loop" is a double-track line 2 miles in length, located on Van Buren Street, Wabash Avenue, Lake Street and Fifth Avenue, a rectangle surrounding the business and shopping section of Chicago. On the inner track run the trains of the Metropolitan and South Side Elevated roads, and on the outer track, in the reverse direction, run those of the Northwestern and the Chicago & Oak Park elevateds. This requires a crossing at grade of the traffic of the various roads. At the southwest corner of the loop (Fifth Avenue and Van Buren Street) the Metropolitan trains enter and leave, passing to and from their own tracks to the inner track of the Union loop. The Northwestern and Oak Park trains cross the outgoing and incoming tracks of the Metropolitan, and South Side trains occupy the inner curve when passing from Fifth Avenue to Van Buren Street.

To obtain the greatest capacity, incoming and outgoing Metropolitan trains move simultaneously through this junction, and similarly South Side and Northwestern and Oak Park trains are handled by one movement.

This results in the following train movements on every week day, Sunday being somewhat lighter:

TRAIN MOVEMENTS—METROPOLITAN JUNCTION, UNION LOOP, CHICAGO

During twenty-four hours, 1776 trains are handled, averaging one every 49 seconds.

During two hours, 4:30 to 6:30 p. m., 263 trains are handled, averaging one every 27½ seconds.

During one hour, 5 to 6 p. m., 163 trains, averaging one every 22 seconds.

During fifteen minutes, a. m. rush, 75 trains averaging one every 12 seconds.

The South Side Junction, at Van Buren and Wabash Avenues, is simultaneously handling substantially the same train movements.

During rush hours practically all of the trains consists of five cars, there being only a few of four cars.

When you stop to consider that this is not a single isolated performance, but the daily week-day routine, and that these rush hours from which the above congested periods are taken occur twice each day, it gives a good idea of the precision and regularity with which electrically equipped trains can be handled.

Follow this matter a little further in detail, and note what is exacted from this set of train units, above the mere promptness with which they pass this point in the system.

Referring to our map, we will note that the Union loop receives the trains of four distinct elevated railway lines.

Now, in order that this junction shall operate smoothly, the trains must be at their targets ready to move instantly when given the signal. They cannot be lined up in a row to insure this condition, otherwise the passengers will be delayed and dissatisfaction ensue. The running time cannot be lengthened out so that the motorman can loaf along and bring his train to this point with ease, for the street car competition is severe, and the time must be cut to a minimum. The various roads maintain on their own lines during the rush hours schedules of from 14½ to 15½ m. p. h., including stops. It takes practically the entire equipment of the road to fill the rush hour schedules, so that running out gap-trains is not generally possible. Here, then, we find trains of five cars passing through this junction "on time," delivering or receiving their heavy load, returning to their outer terminals and again returning a second time in the same

rush hour period and "on time." Add to this that the Northwestern runs express and local trains, making entirely different runs on separate tracks after leaving the loop. The South Side runs trains into its Congress Street stub terminal. The Lake Street runs also into its Market Street stub, and further, the Metropolitan has four distinct branches, from each of which is run not only the loop trains, but an equal number of Fifth Avenue trains, leaving the outer terminals alternately with loop trains, and running into the Fifth Avenue terminal. The Metropolitan loop and Fifth Avenue sets of trains each run on a 1½-minute interval, the Fifth Avenue terminal also accommodating the interurban trains of the Aurora, Elgin & Chicago road on a 15-minute interval during the rush, those passing over the Garfield Park line to the city limits. That such a complication and frequency is in itself desirable I do not pretend to claim, but that it is a demonstrated operative fact is undeniable.

The amount of service exacted of the equipments of these roads is also interesting, it being a fact that practically all of the motor cars on the Metropolitan Elevated, for example, except those in the paint shop or in the general repair shop for general overhauling, are in service every rush hour. This is accomplished by arranging for the inspection at other than rush hours, and by the use of extra motor trucks, which are interchangeable.

Some of these cars, of course, make only two trips each rush hour, but they were ready for further use if required. The total mileage on the Metropolitan Elevated for 1905 shows an average of 24,740 car-miles run per car (motor and coach) per annum, which, considering that 50 per cent of the passengers are handled in four hours of the day, shows a high degree of "availability for service."

A detailed record of 105 Metropolitan Elevated motor cars, which made over 3500 miles per month each during the twelve months from May 31, 1905, to June 1, 1906, shows that the general periodic overhauling, the regular inspection at terminals, and time in shop for repairs to the electrical apparatus, running gear, air brakes, and all parts of the equipment, calculated in hours, amounted to less than 3 per cent of the time. In other words, these cars which did the heavy work during the year 1905-1906 were available for service 97 per cent of the time.

To accomplish this service the following method of inspection is used:

Motor cars are inspected at terminal loops every 600 miles; this takes one hour per car.

Cars are given general overhauling of motors and control every thirteen months; this takes generally two days.

Motor cars average generally on this road 4500 miles per month.

Generally speaking, the statistics for steam locomotive service indicate that from 8 to 12 per cent of the time out of service represents a high state of efficiency, while on some roads 25 per cent of the time "in shop," or an "availability for service," of 75 per cent is nearer the figure for locomotives making a mileage comparable with electric motor mileage of 4500 miles per month, which we have been considering.

It is true that the elevated service, on account of its short intervals between trains, its frequent stops and comparatively light train units, presents an ideal field for electric operation, nevertheless the extent and period of constant service these systems have gone through brings out some advantages which are interesting in connection with recent and proposed heavy electric traction developments. I think we may say that consideration of the records and results of elevated electric operation, aside from the much argued question of economy, shows clearly the three following advantages over steam operation:

1. An increased capacity per car unit due to greater "availability for service" and higher schedule speed.

2. An increased capacity for the system in general, due to shorter intervals possible at terminals and junction points, abolishing of relays, and general facility for handling at stops and in yards.

3. An increased earning capacity due to 1 and 2, and to more attractive service by reason of greater frequency of trains possible with economy, a cleaner and quieter service, etc., giving returns in larger proportion than the direct ratio of apparent increased facilities.

In regard to the results to be obtained by substitution of electric for steam apparatus under somewhat similar conditions on the larger steam railway system, we might reasonably expect to realize the first item, as it is inherent in the nature of the apparatus when its use has been developed to meet the local conditions. This is amply demonstrated, not only by the examples here given, but by the performance of electric railway equipments generally.

The second item is illustrated by what we have seen is being done daily on the greatly congested elevated systems, where such service would be impossible with locomotives. This forms, I believe, one of the strongest arguments for the new power, i. e., the possibility of increasing the capacity of large city termini with electric service. Where real estate values are so enormous and the physical difficulties for enlargement of the terminals so great, the increased capacity of the existing site that it is possible to obtain with electricity is worthy of serious consideration.

Given a large city terminal, surrounded with expensive buildings or possibly bounded by important city streets, and which has reached its maximum train capacity with steam operation, and we are confronted with enormous expenditures to materially increase the capacity with the old motive power.

With the electric equipment the absence of smoke allows of double-decking, as is being done in the New York Central station in New York. The necessity for a local coal and water supply, round house, etc., is done away with. The hauling of passenger trains with multiple-unit control, which eliminates relay switching engines, and adds to the flexibility and ease of handling the units generally, effects an increase in the passenger capacity that could not be obtained with steam without abandoning the existing location or entering into purchases and street-closing proceedings that would prove prohibitive in every way.

The third item is one only just being realized in its true extent by railway men. It is a curious fact that electric service actually seems to create business; not only do we see this illustrated in the elevated systems we have been considering, but in interurban work as well. An electric line has often been known to run through a series of towns paralleling a steam railroad, and develop a traffic largely exceeding that lost by the local steam line. This additional business being apparently created without increase of population, and due to the more frequent and convenient service. It is a peculiar fact that the American citizen is essentially restless and impatient, and given two competitive systems, he will take that offering the most frequent service, even at a little expenditure of time. He does not want to wait. He prefers to keep moving. Again, trains run on even fractions of an hour are more attractive to him than those run irregularly; he is impatient of time tables; he will not hunt through the a. m.'s and p. m.'s of a steam railroad time table when he knows that every hour, half, or quarter-hour there is an electric car.

All of these items are at the basis of the successful inroads made upon steam railroad passenger traffic by the electric lines, and I present for your consideration the suggestion that what has been found true of passengers may in a degree be found true of local freight business as well. Is it not possible that a modification of present steam railway methods may be found profitable in the handling of freight where it has to be hauled with electric traction?

Economy and efficiency in steam railway practice point to constantly increasing size of train units. The lessons of electric operation are just the reverse.

The physical drawbacks involved in steam operation of the large railroad terminals were primarily instrumental in clinching the arguments for "heavy electric traction" for terminal operation. That this system when once introduced in even this limited form will extend to main-line work seems certain. That we shall see radical changes in steam railway methods in yarding and despatching trains, in reduction in size and increase in number of train units, will, I believe, follow as an inevitable result of the application of electricity to steam railway operation.

INTERURBAN FREIGHT AND EXPRESS

BY EDWARD C. SPRING,
General Superintendent the Dayton, Covington & Piqua Traction Company, West Milton, Ohio

The recent enactment of legislation in many of the Eastern States favorable to the handling of freight and express matter by electric lines has caused the operators of such roads as are affected to inquire into the feasibility of establishing a freight or express business on their lines. Hitherto the handling of trolley freight has received comparatively little attention in the East, and considerable less in general than the attention given to it in the Middle States. Massachusetts interurban railway companies have recently been granted permission by the Railway Commissioners to engage in the freight business. A similar action has been given in favor of the interurban systems of New Jersey.

The Massachusetts legislation has established a very liberal policy to permit street railway companies to carry freight in order to afford additional facilities for the transportation of merchandise and farm products, thus giving to the people in localities where steam railroad facilities are limited a decided boom. Naturally Eastern operators are looking to the interurban lines of the Middle West for a solution of this problem, where freight and express services have been in operation for some time, but, as a fact, the roads of the Middle West have not fully demonstrated or satisfied themselves as to the best course to be pursued in taking care of this new branch of the service.

A diversity of opinion exists among the managers of the electric roads, whether it is more advantageous to handle merchandise at express or freight rates. Each manager has his own personal opinion and ideas along this line, and in summing them up we cannot but see that each man's opinion is based upon peculiar circumstances prevalent to his own property. The steam roads of the country have the advantage over the electric lines in this respect, as their conditions are more of a universal or standard nature.

In looking over statistics in regard to the handling of freight and express matter, the diversified conditions that exist among the various roads, and the difficulty in harmonizing those various conditions presents a situation each operative manager must decide for himself. One of the problems that presents itself is the difficulty in drawing a distinct line between freight and express traffic, as handled by electric roads, for the reason that the freight branch of the business has not developed sufficiently so that a point of difference can be made between freight and express traffic.

The word freight as applied to steam roads cannot, in its literal sense, be applied to the electric lines at the present day. To do a freight business in its literal sense means the handling of freight in carload lots by trains. The number of roads in the country to-day equipped for such service with sufficient length of track to make the same of a profitable nature is very small. Our power stations are not equipped for this extra heavy service, neither is our rolling stock sufficient, or physical conditions of our track in shape to withstand the wear and tear of such service. In view of these facts, which are all well known to you, the various roads must confine themselves to light freight and express service, and it is useless for us to think of competing with steam roads in handling freight in carload lots at this time. But the handling of light freight and express has been so successful that the question of handling carload lots is being seriously considered, and has been successfully accomplished by a few roads, but a carload freightage over connecting lines is a problem yet to be worked out. A universal interchangeable freight traffic and the prorating with the steam roads are two matters which the officials of the steam roads have, up to the present time, been reticent in entering into with the electric lines, although few of the smaller steam roads have entered into traffic arrangements with some of the electric lines.

The growth of the freight and express business during the past four years has been wonderful. The frequency of service and the connecting of small towns between cities hitherto isolated from the outside world have been two of the greatest factors for the development of this branch of the service. The handling of fruit and garden truck, on account of the despatch of carrying these perishable goods, is fast becoming a source or revenue to interurban freight handlers.

The number of advantages offered by the electric lines in the handling of commodities is fast becoming more apparent each day, each road having its own particular line of goods from which it derives the greatest part of its revenue. The placing of the farmer in close touch with the market of the civilized world through the medium of the electric lines, offers in itself one of the greatest inducements to the interurban lines running through a farming community. In handling this class of business each company should be provided with ample equipment to handle all business offered it daily without difficulty. Motor cars should be so equipped that trailers could be handled without delay. Each company should have several box-car trailers to take care of carload business in addition to the handling of local freight. The handling of merchandise with trailers as much as possible would serve to hold down the operating expense of the department. Freight stations and platforms erected along the line to stimulate the traffic and enable the handling of freight more carefully and with greater despatch, and also makes a convenient place for the transfer of merchandise to the teamsters. In all cases we must offer the same inducements to the shippers as are prevalent with the steam roads. Competent men should be in charge of these stations, who should be intelligent, sober and industrious, because these agents come in close contact with the public in the freight department, the same as they do in the passenger department, and in a marked degree the success of the company is dependent upon these representatives. Agents should be conversant with the freight tariff, so that they can immediately quote any desired rate to the shipper and give any information sought for the forwarding of goods from any local point to a destination on a connecting line. The interurban freight stations at Cincinnati, Ohio, and Indianapolis, Ind., afford two of the best object lessons in the handling of freight at large terminals.

All matters pertaining to increasing the outlay in the freight department should be made in an exceedingly cautious manner. The despatch and promptness in handling merchandise by electric roads will bring better results than any other factors, but the question comes, how shall we handle this class of business in the most economical and efficient manner so that the operation of this department will not eat up all the profits which incur from the business?

I believe that there is great need of a reform in the manner of handling the freight and express business among the major part of the companies through the Middle West. The jealousies which exist between the companies must be done away with, and the hearty co-operation of all roads to one end of serving the best interests of the electric lines must be pre-eminent. The reconstructing of the physical conditions of our properties to meet this branch of business must as well be taken into consideration. Above all things I would not for a moment encourage any road to go into the freight or express business to the detriment of its passenger service, although I do predict that the freight branch of the service has a wonderful future. I do not believe that the day will ever come that the freight business will supersede the earnings of the passenger traffic until all the independent roads have consolidated, operate upon private way and with double track. I do not believe that any road can honestly afford to interfere in any way with the revenue of the passenger department.

The road that serves the large manufacturing and commercial centers, where the consignee demands his goods at a given time, and whose business warrants his paying well for their prompt delivery, can do an express business, charging express rates upon a profitable basis, but to engage in a freight business on freight rates under these conditions would be suicidal to the company. On the other hand, any road that operates through a farming district, and caters to the demand of the farmer, to whom time is of a very small consideration, an express service would be entirely out of the question, and only a freight traffic with the lowest possible freight rates should be considered. The farmer has not yet thoroughly realized the advantages which the interurban facilties afford, and charges in excess of the present steam road rates are severely questioned. The merchants in the various farming towns, knowing that the farmers will not pay anything extra for quick service, are equally unwilling to pay more than present steam road charges, and the only way that the electric railway company can hope to obtain a local freight business under such conditions is to place its rates on a parallel with those of the steam roads. Nevertheless, there is no doubt but what in many instances the handling of heavy freight through these farming sections can be made to show a fair return if properly conducted. Tobacco, corn, wheat and oats can be successfully handled to a profit under many conditions. A road operating through a farming community installing freight buildings, built exclusively for this purpose, offers a very attractive feature, inasmuch as the road can receive large consignments and deliver them at its own pleasure, thus oftentimes being able to compete with the steam roads, the freight-house taking place of the freight-car capacity of the steam roads.

I think that the position on the part of the electric lines to follow steam road methods, representing, as they do, years of experience, is an excellent one. I would not for a moment recommend any cut below the steam roads or express traffic, particularly between competing points. We have a chance now in this comparatively new field of the service to maintain a standard of rates and not again experience a condition of affairs the same as we have experienced in the passenger business, and later be obliged to change our rates. The drawing of the line between the freight and express business is one which must be decided by the operator. I do not believe that an express service on a short line can be maintained as profitably by the railway company itself as it can be by a regular line express company operating over connecting lines, and again, I would cite the experience of steam railways in this respect.

After the division of rates among the various companies the percentage that would revert to the company that originated the business would be so small, that in many cases business would be done at a loss. One of the greatest expenses in the maintenance of the through express business is the delivery and collection by wagons. There are very few places on interurban roads where the companies can afford to maintain regular delivery wagons. The only possible way to maintain an express service under conditions that do not warrant the maintenance of wagon service is to make arrangements with local teamsters along the line to handle the merchandise between the car and its destination. Many roads have endeavored to maintain such a service, but have been obliged to discontinue it, and transfer their business to some electric express company organized for this class of work. One of the best examples of this class of service is the magnificent system of the Cleveland Electric Package Company, which handles the majority of the merchandise carried over the electric lines in and out of Cleveland. This system is a positive proof of the best manner in which to handle a strictly express business. The Southern Ohio Express Company, operating between Dayton and Cincinnati, offers also another demonstration of the feasibility of turning all express matter over to a regular express company.

In adopting a line of operation, each manager must be governed almost wholly by the local conditions, not only to his property, but those connected with him, and judge for himself the best line to work upon. I believe that the roads throughout the country should look toward the standardizing of the freight and express business, the same as we are endeavoring to standardize our equipments, and if the problems are adjusted, we should see the results in cheaper operation and increased revenue. Already the interurban freight radius has grown from the distances between the towns and villages to hundreds of miles. Realizing that this phenomenal growth has taken place within a few years, it is within the bounds of possibility that in the future railway builders will so construct electric lines that they should rival, to a great extent, steam power systems in their capacity for hauling long-distance freight. And as the industrial and commercial needs press the interurgan people to keep pace with the demand for greater freight transportation, this need will be met in the same energetic and progressive manner as has characterized the past development of passenger transportation.

In summing up this article, I have not tried to go into detail at all, or statistics, as the same would make too lengthy and tiresome a paper. I have simply looked at the plain facts as they have presented themselves to me in careful observation of the various lines in the Middle Western States. I have not touched upon the classifications of accounts, as this is an independent subject within itself. I would not discourage any road from handling heavy freight, because the standard electric equipment is not able to take care of shipments in less than carload lots, which is practically express. However, since the advent of some of the later forms of alternating-current motors, electric roads may be equipped for handling freight. Taking into consideration the power of a freight locomotive, which is from 600 to 1000 hp, such a current thrown on and off at some of the power houses would only meet with disastrous results. While an old road may be equipped for the handling of heavy freight, the expense of equipment would not be justified by the amount of business that would be handled. A good many electric roads which are handling freight use a steam locomotive with good results. Too many roads figure on high freight rates, while, as a matter of fact, they can get but little more than the steam roads; people are not after quick delivery on freight; that is express. The smaller steam roads are getting near 4 cents per ton-mile, while the larger roads are getting between 1 and 2 cents, so that an electric road would have to handle a great deal of business to make money at this rate. The steam locomotive offers the best solution for most of the roads built, about half of which could operate a light locomotive by changing a few grades, curves, etc., while some roads are built on steam road standards in the country, track construction in the city prevents operation even if city ordinances do not prohibit it.

You will pardon me if I have been too severe in my comment upon the freight and express branch of the service, but being in a position as I have been, and watching the operation of the same in the Middle West, I cannot help but feel that there is a tendency to over-estimate this branch of the service to the detriment of our passenger business.

ELECTRIC RAILWAYS IN SPARSELY SETTLED COMMUNITIES

BY E. P. ROBERTS,
The Roberts & Abbott Company, Cleveland, Ohio

What is a sparsely settled community? Does it mean that it has only a very small population, not only along the route, but also at one or both terminals? Or does it mean that the country through which the road passes has a small population per mile of road, but that there may be considerable population at either or both terminals?

Moreover, from the income standpoint, the term is a relative one, as in some sections of the country the income per capita may be twice, or even more than, that obtained in another section, perhaps because of greater reasons for travel, or because of less competition, or for the reason that such better earning road can readily obtain remunerative rates. Even when comparing roads in the same general locality, the greater income per capita may also be due to a greater demand for service. For example: the income per capita and per mile of road is frequently quite dissimilar for different roads running into the same terminal city, and also for roads operating in the same portion of a State, but serving entirely separate sections. Moreover, the cost of construction and the cost of operation and the rates which can be obtained must necessarily affect the decision as to the advisability of constructing a road, whatever may be the population.

In addition, the term "sparsely settled" undoubtedly refers to population only, whereas the writer firmly believes that there are situations where it is advisable to construct electric roads equipped for the handling of freight in trains, in addition to carrying passengers, package freight, and express matter.

Possibly the title was meant to refer to roads having a large principal terminal city and having a population of less than 800 or 1000 per mile of road, exclusive of the population in such principal city, but a number of roads having less population have an excellent income per mile of road.

Possibly, however, it may be taken as referring to roads having such a light passenger travel as can practically always be handled by one medium-sized car operating on hourly headway for ten or twelve hours daily, and less frequently during the remainder of the twenty-four, and also less frequently for several months annually. The writer's opinion is that probably no electric railway which is almost entirely dependent upon passenger earnings is justified, unless at least hourly headway for the greater portion of the time is required to handle the business, and that even for such a road it must be possible either to construct the road in a manner adequate for the purpose, at low cost, or higher rates must be charged than are usually obtainable, at least in most sections of the country.

Considering the subject assigned, as designated by its title, it would appear that only passenger traffic was to be considered, and, if such is the fact, the writer would suggest that if the country is sparsely settled, it is better not to construct an electric railway, but, as before stated, "sparsely settled" is a relative term and reasons for travel and rates obtainable are of vital importance, and passenger traffic is not the only source of income.

Later are presented a few records relative to interurban electric roads which show in a general way that the receipts per capita decrease as the density of population increases; but the individual variations from such general proposition are so great as to make it evident that a mere statement that the population is dense, or that the country is sparsely settled, does not determine the question as to whether or not to build an electric railway in any specific territory.

The following remarks will usually apply to any interurban electric railway.

What is the purpose to be accomplished in building a proposed interurban electric railway? Is it merely to obtain promoters profits, or for a real estate deal? Or is the principal object to obtain a road which will be a good investment? The term "good investment," as here used, means something additional to what would be obtained from a well-protected loan, such additional amount being on account of the risk assumed by the stockholder, and is the "speculative profit."

The writer refers to this additional profit because there is so much criticism on account of securities (bonds and stock) usually being in excess of the physical value, such excess is

frequently referred to as watered stock. As a matter of fact, many of those who are most rabid in their criticisms will not take the risk necessary "to get in on the ground floor," though probably any one would be willing to purchase such securities on the original basis after success has been demonstrated, and would have no compunctions.

The foregoing remark is not meant to excuse many objectionable, even if legal, practices, and I believe that in many cases promoters, syndicate managers and others, have robbed investors and wrecked properties, and that also in other respects their actions have been harmful to the individual and to the community. On the other hand, the investor who takes the risk is entitled to an indefinitely large return if he can properly earn it. Although, because of the failings of human nature, it would appear that there must be governmental regulations for interurban electric railways, as well as for other public service corporations, and that it is probably wise there should be a large amount of publicity relative to the finances, nevertheless, the fact that an investor, after taking a risk, makes 20 per cent or more on an investment is not, in itself, a reasonable or just excuse for forcibly reducing his earnings.

The writer has not overlooked the fact that publicity and many governmental regulations are for the purpose of protecting investors, and that the right of eminent domain is given in order to serve the public, and implies the receipt of an equivalent; but these, and other matters which could be referred to, do not affect the general principle set forth.

We will now give some consideration to the points which should be taken into account when investigating the advisability of constructing any proposed interurban electric railway, and we will proceed on the basis that it is to be properly financed, designed, constructed and managed. Before presenting the points above referred to, I desire briefly to call attention to the various types of electric roads, as it is not unusual to hear even electric railroad men use the terms, "street railways," or "suburban railways," when referring to what are properly "interurban railroads."

There are two general classes of electric roads: Street railways and railroads. The street railway is, with improvements, the electrified horse car, and is operated along much the same lines; whereas, the electric railroad is, to an increasing degree, the electrified steam road, and operation is, with necessary modifications, along the lines of steam railroading. To further differentiate, we may consider three classes: the city, or urban; the suburban, and the interurban. It is impossible to make a definite classification because many roads belong to more than one class, or are on the dividing line between two classes.

The city line proper is one lying entirely within the limits of a city, and, in general, its receipts depend upon the magnitude (population and area) of the city rather than upon the population per mile of road, as in the small cities the distance from residence centers to business centers is usually short, and the people can and do walk. On the other hand, in the large city the distance between residence and business center is usually large, and people ride more frequently than in the other case. As a result there may be a smaller population per mile of road in a large city, and yet such road may have far greater receipts per mile and per capita than in the smaller city, where the population per mile of track is greater.

Of course local conditions and peculiarities affect, to a large degree, the earnings, but generally speaking, electric railroads in large cities show much larger earnings per mile and per capita than those in the smaller cities. One of the local conditions above referred to is the distribution of the population; a city or town along a river, or valley, will frequently allow one line of track to serve practically all the population, the distances between residence, business and manufacturing sections being such as to assure riding.

Suburban roads are usually an extension of the city system and operate on highways, frequently with cars of the city type. The schedule provides for rather frequent stops, though less in number than for an interurban road. The car equipment is, or at least should be, provided on such basis. Suburban roads may be classified as those connecting a terminal city with one or more outlying towns and villages, and those which serve a suburban residence district. Generally speaking, the latter class will show greater earnings per capita for equal density of population, excluding the population of the terminal city from the population per mile of road.

Freight traffic on a city road is nearly always a negligible quantity, but in the case of a suburban or interurban road may reach a very respectable value. The electric roads doing the largest freight business are usually those which run through the most sparsely settled districts. This is frequently due to the fact that the steam freight service in such district is usually very limited, or entirely absent. It is also a fact that such roads are generally constructed with the expectation of doing a considerable freight business, or, in the same cases are forced to develop such business because of the small passenger traffic. As the light passenger traffic can be taken care of by cars operating under considerable headway, the track is available for freight service. In most cases such roads have single track, with sidings of such length and location as may be required.

The function of the three general types of roads referred to are somewhat indicated by the type of cars and motor equipment, which for each type is, or should be, provided.

A city car should have the seats so arranged as to be reasonably comfortable, but if any cross-seats are used, and as the rides are comparatively short, high backs and ample knee room are not essential, but it is necessary to have ample standing room and especially ample space near the doors, also a large rear platform and easy steps. Generally closed cars have longitudinal seats only, but if cross-seats are used they should not be near the entering doors, and some cars have a rail on the rear platform designed to prevent congestion at the entrance. The motors are comparatively small and are geared for low speeds.

The cars for suburban roads are generally somewhat larger and frequently have cross-seats, and, because of the longer ride, are designed to give greater comfort to the passenger, but, as the city portion of the run is a considerable percentage of the total, and as in the suburbs there will be rather frequent stops, considerable attention must still be given to furnishing facilities for the quick loading and unloading of passengers.

Not infrequently suburban roads, or those which should properly be designated as suburban roads, are equipped with large and heavy cars geared for high maximum speeds and attempt to make fast schedules, while at the same time doing a suburban business and making very frequent stops. Such practice is almost always uneconomical, as it gives on the one hand, a poor suburban service, the cars being too large, the seating not best suited to the service, the headway infrequent; on the other hand, a wretched interurban service. A heavy car geared for high speed is very poorly adapted to suburban service with its frequent stops, and also results in an excessive amount of power for the service given.

Where the number of stops is large, it is folly to gear a car for high schedule speed. In fact with from six to eight stops per mile it is useless to gear a car for a higher speed than from 25 to 30 miles an hour, as no gain in schedule speed at all commensurate with the cost can thereby be obtained. Another difficulty arising from the use of large and fast cars for suburban service is the necessity for the high rates of acceleration which are required in order to make the time-card when the traffic is heavy and the stops numerous. Such high rates of acceleration require large and expensive motors, and make very heavy demands upon the power house, sub-station and line.

The most desirable passenger car for any interurban road depends upon the character of service. A road having a comparatively short run, and with frequent stops, should have a car and motor equipment very similar to that previously described for a suburban road, while on a road of considerable length, and especially for such cars as are used for limited service, the design should be based on giving comfortable seating, all, or practically all, seats being cross-seats, with high backs, long and wide seats, arm rests and ample knee room. In order to accomplish this the aisle room must be cut down and the seating capacity per foot of length decreased, and small platforms can be used.

The illumination should be carefully arranged and be liberal in amount, and a toilet room and drinking water provided. In other words, the accommodations should be similar to those of a steam coach.

The motor equipment should be designed for the required schedule on the country run which, for nearly all recently designed roads, is on private right of way.

The equipments should always be geared for the very lowest speed that will make the required schedule, plus a sufficient margin for delays. Any higher gearing results in an unnecessary expense for car equipment, in some cases unnecessarily high repair bills, unnecessary expense of power, and also a larger power-house and sub-station equipment than would otherwise be required, consequently increasing the financial charges. The motor equipment selected should always be of ample capacity for the work which it has to do. New equipments may be

heavily loaded for a long time before the effect of such overloading becomes evident, and smaller overloads are very slow to show their effect. But when the trouble once starts it will come all at once.

It sometimes happens that a road will increase its schedule speed, making the necessary changes in gearing to secure the required maximum speed, and apparently everything is lovely, but in one or two years there comes a sudden epidemic of burnt-out armature and field coils, and within a very short period it is necessary to rewind practically every motor on the road. This is the inevitable result of long continued overload.

The foregoing remarks relative to the motor gearing and the capacity of motors are also applicable to motors for city and suburban cars, and are so evident as not to need any explanation, but there is one other point which is sometimes overlooked, and that is the effect on motor capacity of low voltage, especially on heavy grades. The capacity of a motor is practically limited by its heating. The heat generated in a motor (excluding iron losses) is proportional to the square of the current, and when the current varies is proportional to the mean square of the current. Therefore, the heating for variable current is greater than the square of the average current. In other words, if the motor is taking 50 amps. for 30 seconds and 150 amps. for another 30 seconds, the heating is greater than if it took 100 amps. for 60 seconds.

The speed is approximately proportioned to the voltage, and the torque is approximately proportional to the current.

If, therefore, the voltage is lessened and the schedule maintained, the motors must be accelerated as rapidly as possible, full speed must be maintained as long as practicable and no coasting is permissible; the result being that the average current flowing during the period from start to stop will be greater than would have been the case if the voltage had been sufficiently high to permit of lower rates of acceleration and some coasting before braking begins. If there be a grade to climb, the current taken will be approximately the same at low voltage as at high voltage, it being presumed that in either case the motors are operated at the same controller point, but the time will be longer in the first instance, and consequently the heating during the climbing will be increased. If after the car reaches the summit it immediately runs on a down grade equal in degree and length to that just climbed, it might seem that there would be an opportunity to equalize, but such is not the case, for the reason that the mean square is not the same as the square of the average. Even if such were a fact it would not often apply, for the reason that, if time is lost on the up grade, the motors will be crowded so as to make the best possible time on the down grade; whereas, if there were ample time, the down grade might be coasted either entirely or to a large degree. In other words, the effect of the low voltage and the grade is to "hit" the motors "coming and going."

THE VALUE OF STATISTICS AND THEIR PROPER AND IMPROPER USE

Undoubtedly statistics are frequently of great value, but it is also a fact that they are often misapplied, and in such cases are worse than useless, and such application has led to the paraphrasing of the Western comparative expression, "liar, damned liar, mining expert," into the "liar, damned liar, statistician." Another statement somewhat along the same line, but with adifferent underlying thought, is that "figures can't lie, but liars can figure."

The foregoing refers to statistics in general, but we will now consider same with special reference to interurban electric railways.

The special report of the United States Census Office relative to street and electric railways, 1902, undoubtedly contains much information of value, but the data therein presented has frequently been misused. Average results for the United States or for individual States have been considered as applicable to a proposed road; whereas, in the writer's opinion, each proposition must be considered by itself, and only such statistics applied as are obtained from roads which are properly comparative, and as no two roads are identical, allowance must be made for the difference between the proposed road and such road or roads as are compared therewith. Even the fact that the proposed road has the same terminal city as the roads with which it is to be compared, and has the same population per mile of road, does not make the two propositions strictly comparative. For example: One proposed road may have to meet a different character of competition; or there may be greater or less reason for travel; or, the population may be differently distributed as to town, village and country population; or, it may be a different class of population, manufacturing or agricultural, all of which affects the probabilities of travel; or there may be a difference in the amount of express, package freight or carload freight which can be obtained; or there may be a material difference in the length of run in the city, or a material difference in first cost, thereby affecting the financial charge. For example: Some time since the writer had occasion to report relative to a proposed road entering a large city, and not only had the statistics but also intimate knowledge relative to six of the eight roads entering such city. Three of the six roads were not considered as being at all comparative with the proposed road, the other three were considered as somewhat comparative. The income from one of the latter roads was $6.50 per capita, exclusive of the population of the principal terminal; for another road $6.53, and for the third road $7.00. Nevertheless, in making the report for the proposed road, none of these figures nor the average was taken, but a figure slightly lower than the lowest. This was done, not in order to be conservative, but as honestly expressing the writer's opinion.

The foregoing indicates the possible erroneous conclusion, even under a condition exceptionally favorable to the use of statistics, but if the average result of all roads in the general territory is used or if statistics obtained from one portion of the country are considered as applicable to another portion, then the conclusion reached is practically sure to be very different from the result which actually will be obtained.

As an extreme example of the misapplication or misunderstanding of statistics, the following may be of interest: Some time since, a report was brought to our office, which, from the civil engineering standpoint, was excellently prepared, although very weak and inaccurate as to the mechanical and electrical portion. It was, however, artistically bound, profusely illustrated with excellent photographs, and calculated to create quite an impression. When the writer turned to the page relative to "income," the amount was so large as to be surprising, particularly as he had been over the route. He asked the basis of the estimate and the following statement was made:

In the United States census report relative to street electric railways, 1902, it had been noted that the average income per car-mile for Ohio electric railways was $3.43, and as they desired to be conservative, they used a figure which, as I recollect it, was approximately $2.50. I immediately informed the gentleman that he was in error, and handed him the Census Report, and he turned to a column headed "fare passengers per car car-mile," and which had the figures 3.43 which he had taken to mean dollars and cents, whereas, of course, it meant persons, and then I suggested that he divide the anticipated income by from eight to ten, which naturally seriously affected the findings as to the estimated income.

SOME STATISTICS RELATIVE TO INTERURBAN ELECTRIC RAILWAYS, AND DISCUSSION OF SAME

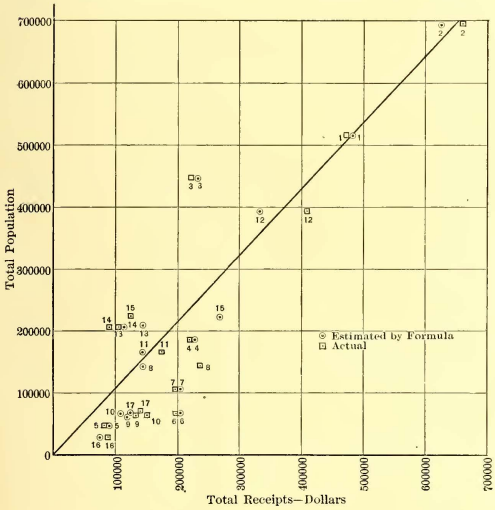
The writer has always felt very strongly that each case must be considered by itself, but in view of several letters recently received, one from the editor of a technical paper and others from engineers, asking how we figure probable earnings of interurban railways, and whether it is not possible to obtain an empirical formula which would have some value, we prepared several tables and attempted to obtain a curve which might have some value. Curiously enough, the first eight or ten roads tabulated gave such results as checked, with not an excessive variation, with the empirical formula suggested by one of our engineers; but even then there was such variation as would be sufficient to make the difference between profit and loss. This formula is based on allowing a certain annual income per capita from the population in the principal city, a greater amount in the towns, and a still greater amount in the country; but applying some additional data, we found that for many roads the suggested formula had no value at all. The formula is not given for the reason that it might be used even though it is misleading. Table No. 1 and curve No. 1 show the application of the formula. The first portion of the table gives those to which the formula is applicable and which encouraged us, even though the writer could not see that there was any reason to anticipate that any formula would prove even approximately applicable, but the balance shows the fallacy of anticipating that any formula can be found which will be of service. One table and curve, however, are presented, which seem to us to have some value, taken merely as an indication and never applying to any individual case the results indicated by the curve.

TABLE No. 1 AND CURVE No. 1.

Road Number.	Total Population.	Earnings Estimated By Use of Formula.	Actually Earned.	
1	518,550	$478,252	$475 361	Close
2	693,598	623,478	659,873	Fair.
3	445,259	229,524	225,760	Close.
4	185,425	237,377	219,188	Close.
5	47,840	88,500	85,055	Close.
6	67,811	200,300	198,500	Close.
7	104,807	204,500	195,000	Close.
8	141,214	144,000	234,278	Very bad.
9	64,933	117,000	131,000	Fair.
10	66,398	107,000	148,700	Bad.
11	165,903	141,000	171,671	Rather bad.
12	394,728	333,000	406,000	Bad.
13	207,000	144,000	106,782	Bad.
14	207,077	108,500	95,000	Rather bad
15	224,255	267,500	122,000	Very bad.
16	28,392	74,000	84,822	Close.

The above population includes the entire population on and tributary to the line, including terminal cities regardless of their size.

The population stated by the tables and curves as being along the route is not based on that within a certain distance of the road, but is based on local conditions. To ascertain same neces-



CURVE NO. 1

sitates more time and skill than when the latter method is followed, but it is the one which I consider proper, and consequently is followed by our office.

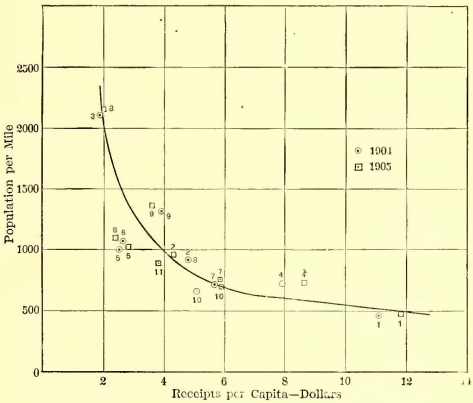
We always consider the entire population directly on the route, and when one city greatly preponderates exclusive of such principal city, but noting the population of such city, and when there is no such greatly preponderating city we consider all the population. For sections a greater or less distance from the route we use a percentage based on local conditions, and take into account the character of the population, the reasons for travel, the comparative facilities, including accessibility, etc. For example: Near the principal city a person residing 3 miles or less from the corporation limits of the city, and 3 miles from the proposed road, would seldom, if ever, use same, whereas if he were a considerably greater distance from the city, and 3 miles from the road, he would use it almost as much as if he lived directly on the route, provided that there was not another electric or a steam road nearer to him. If such road were a steam road consideration would be given to the service provided by it.

It is also evident that if the location of the proposed road is along a river, especially of considerable width, and having a few bridges, the population on the other side of the river from the road has lessened in value; it might not, geographically speaking, be a quarter of a mile distant, but from the standpoint of accessibility may actually be several miles away. In some cases, and because of connection with steam or electric railways, or river transportation, or existing stage routes, considerable value should be given to a population at a considerable distance from the route, whereas in other cases, and as above indicated, the population quite near the route may have little value.

The population so obtained is what we term the "equivalent" population, by which is meant the population which, if all of it were directly on the route, would equal in amount of travel the actual population as it is actually located. For example: a population of 1000 may be considered as equal to 100 or 200 or more directly on the route.

Relative to the population, our custom is to take the 1890 and 1900 census and note the rate of growth, and also to give due consideration to the school and voting population, etc., and checking any statements as to unusual growth, or growth at a more rapid rate than between 1890 and 1900. For example: the census records for Oklahoma have little value, and there are portions of the country where the voting record is not of great value, and where the income from the population is not so recorded is very considerable. The ratio of the total population to the school or voting census is quite different in different sections, and in the country and in towns, and in order to obtain the proper multiplier we compare the last United States census with the school census at such time.

Relative to the population which should be considered, we give separate value to the principal terminal city when it is much larger than any other city along the route. The writer's present opinion is that usually it makes little difference to the interurban road whether the principal city had 100,000 or 500,000 population,



CURVE NO. 2

provided that it is the principal city in that general section of the country, and therefore the one to which all business tends.

If the interurban road has a pleasure resort, it might seem fair to presume that it would receive more passenger traffic from a terminal city of 500,000 than it would if such terminal city were materially smaller. On the other hand, the larger city will have more places of amusement, and it is a question whether such seeming probable result will prove to be a fact. The freight and express business from the principal city depends upon the conditions along the route, and the same is true of travel for business reasons, and also largely for social reasons, and is not affected by the size of the principal terminus. The travel into the principal terminus is not affected by its population, provided, as before stated, it is the principal city in the general section of the country.

The receipts per capita depend upon the reasons for travel, comparative facilities, habits of the people, character of population, comparative costs of travel, etc., and to apply any statistics requires not only a careful study of the conditions relative to the proposed road, but also a full knowledge of the conditions relative to the roads from which the statistics are taken, and a careful differentiation and application of such statistics.

Table 2 and curve 2, corresponding thereto, show in a general way for the roads considered, the relation between receipts per capita and population per mile of road, exclusive of the popula-

tion of the principal terminal city. The effect of the population of the principal terminal city is above referred to.

The general characteristics of the various roads are as follows: Curve No. 2 has the population per mile plotted as ordinates, and the receipts per capita (in dollars) as abscissæ. The various points marked on the sheet are numbered to correspond with the following statements as to the characteristics of the various roads. The roads considered are all in one general section of the country, otherwise the difference would have been still greater.

The index numbers following do not correspond with those used for table and plate No. 1.

Road No. 1 is a double-track interurban in the Central West, having its terminal in a large city, but having no other towns of any considerable size. It has a rather large suburban resident population, especially during the summer, and the double-track main line of the road is paralleled by a third track operated by the same company, and 2 or 3 miles from the main line, but connecting with it at both ends. The earnings include both lines. The popultion of the principal city is excluded. Its data are:

	1904.	1905.
Population, total	20,402	20,692
Population, per mile	463	470
Earnings, total	225,751	245,809
Earnings, per mile	5,130	5,560
Earnings, per capita	11.06	11.84

Road No. 2 is a 42-mile road in the Central West, having a medium-sized terminal city, the population of which is excluded from the total.

	1904.	1905.
Population, total	38,469	40,005
Population, per mile	915	952
Earnings, total	181,201	173,153
Earnings, per mile	4,314	4,123
Earnings, per capita	4.71	4.33

Road No. 3 is a 34.14-mile road having several small cities, whose population is included in the totals.

	1904.	1905.
Population, total	71,338	73,249
Population, per mile	2,100	2,150
Earnings, total	136,918	147,851
Earnings, per mile	4,000	4,330
Earnings, per capita	1.90	2.20

Road No. 4 is a 39-mile road having a large terminal city and one smaller terminal city. The larger city is excluded and the smaller city is included in the total population.

	1904.	1905.
Population, total	28,424	28,781
Population, per mile	730	740
Earnings, total	225,410	248,912
Earnings, per mile	57,880	6,300
Earnings, per capita	7.90	8.60

Road No. 5 is an 80-mile road in the Central West, having only one city of any considerable size, and the population of this is included in the totals.

	1904.	1905.
Population, total	80,362	81,851
Population, per mile	1,004	1,024
Earnings, total	205,896	230,758
Earnings, per mile	2,572	2,885
Earnings, per capita	2.56	2.82

Road No. 6 is also a road in the Central West, 30 miles in length, and having one medium-sized city, population of which is excluded from the totals.

	1904.	1905.
Population, total	32,373	32,993
Population, per mile	1,079	1,100
Earnings, total	85,055	80,100
Earnings, per mile	2,835	2,770
Earnings, per capita	2.66	2.43

Road No. 7 is a road in the Central West having one large and one very large terminal city; both of these are excluded from the totals; miles of track, 160.

	1904	1905.
Population, total	116,993	118,957
Population, per mile	731	743
Earnings, total	660,000	699,339
Earnings, per mile	4,125	4,370
Earnings, per capita	5.64	5.87

Road No. 8 is also in the Central West, having 92 miles of track and one large terminal city, the population of which is excluded from the totals.

	One half 1904 and One half 1905
Population, total	85,082
Population, per mile	924
Earnings, total	404,880
Earnings, per mile	4,400
Earnings, per capita	4.75

The above figures are for the last half of 1904 and the first half of 1905.

Road No. 9 has one large, one medium, and one small terminal city. The large terminal city is excluded and the other is included in the total; miles of track, 45.

	1904.	1905.
Population, total	59,166	62,124
Population, per mile	1,315	1,353
Earnings, total	234,278	223,605
Earnings, per mile	5,205	5,000
Earnings, per capita	3.95	3.60

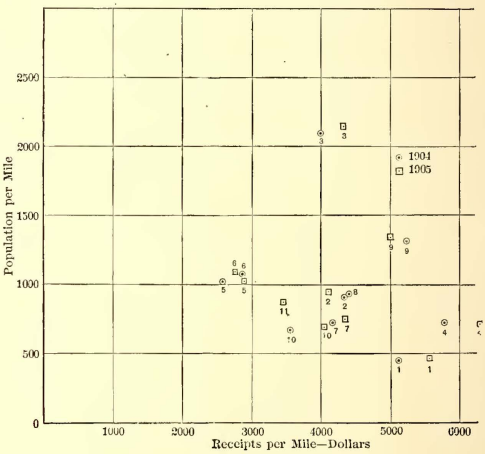
Road No. 10 is a large road in the Central West, having 134 miles of track, and one very large terminal city, the population of which is excluded.

	1904.	1905.
Population, total	92,539	94,200
Population, per mile	692	702
Earnings, total	475,361	543,226
Earnings, per mile	3,547	4,054
Earnings, per capita	5.13	5.78

Road No. 11 is a 58.6-mile road in the Central West, having three small cities, all of which are included in the totals.

	1905.
Population, total	52,052
Population, per mile	887
Earnings, total	197,934
Earnings, per mile	3,475
Earnings, per capita	3.80

Curve No. 3: This has, as ordinates, the population per mile of road and as abscissæ the receipts per mile of road, and it will



CURVE NO. 3

be noted that the effect is that of a shot-gun target, the points scattering very widely and showing no inclination to any definite law.

Evidently this plate has no value, except to show the fallacy of using averages as applicable to any given case.

Examples of the above character could be multiplied indefinitely, but we will now merely refer to two tables in the Street and Electric Railway Census Report for 1902. These tables are found on page 19 of the report. The first table (No. 13) shows for one city of 28,000 people 144 trips annually per inhabitant, and for another city having 60,000 population only 60 trips: whereas the general rule is that the larger the population the greater the rides per capita. The same table shows that for two towns, each having 36,000 population, one had 66 rides per capita and the other 136. Table No. 15, on the same page, shows that the average miles of track per 1000 population increases as the total population decreases, and that the rides per capita vary in the reverse direction.

EXAMINATION RELATIVE TO AN OPERATING OR PROPOSED ELECTRIC RAILROAD

Such an examination necessitates the application of personal judgment, and, to a greater or less degree, the application of statistics—and, before giving detailed consideration to such ex-

amination, it may be well to state the object of such examinations.

The examination of an operating plant is generally in order to ascertain its existing income, gross and net, the past rate of increase of same, and the probability as to the future, its physical value, and whether it is economically advisable to make additions and improvements. An examination is also made of the franchises, and of other matters outside of the construction and operating features.

The examination of the income and expenses is, as nearly as possible, in accordance with the Standard Classification of Accounts prepared by the American Street and Interurban Railway Accountants' Association, and statistics obtained from other roads are compared therewith in order to note any considerable variations from what may be considered as normal, and the reason for any such variation is investigated. Sometimes actual statistics obtained from other roads are not referred to, because the investigator has such knowledge as enables him to apply results he has elsewhere obtained to the case under consideration, and he may do so unconsciously. But whether consciously or unconsciously he uses statistics is immaterial, the principal point being that he does use and compares them with local conditions and applies personal judgment.

If the examination is relative to a proposed road it must include a predetermination of all the factors entering into total cost, both first cost and operating, also income, both gross and net, and evidently requires not only a wide experience, but also excellent judgment in the application of statistics.

The object of an investigation as to the advisability of constructing a proposed interurban electric road is evidently to ascertain the probable resulting net earnings per dollar invested. In order to arrive at such conclusion it is necessary to ascertain the probable gross income, the total first cost and the consequent resulting financial charge and the operating expense. Logically, these matters should be taken up in the order above stated, but in many respects they are inter-dependent, and are considered simultaneously.

A competent specialist by going over the proposed route, can determine with a fair degree of approximation the general character and cost of a road suitable for the general conditions, and obtain a bird's-eye view of the situation, from which he can prepare a general plan to use as a starting point for estimating cost and income. As such simultaneous consideration is impracticable to present in a paper, we will endeavor to consider the matter in a logical manner.

First. The probable income. This may be from several sources —passenger, express, carload freight, mail, advertising, and, in some cases, the sale of electric energy for light and power. The last three sources will be disregarded, and consideration merely given to the income from passengers, express and freight.

PASSENGER INCOME

Having obtained the equivalent population in the manner previously described, the next and most important step is to determine the probable income per capita. Consideration must be given to the reasons for travel, comparative existing facilities, including railway time-tables and rates, and possibilities or probabilities of existing, or of other proposed, roads furnishing increased facilities. The habits of the people must be studied, the existing trend of traffic and every factor which may influence the situation. Some of these factors can be given an approximately definite value, and others are largely a matter of experience. To each must be applied personal judgment and the actual or unconscious application of statistics obtained from other roads having conditions more or less analogous to those of the projected road, and upon the ability to ascertain the conditions and properly apply the results elsewhere obtained depends the accuracy of the predetermination.

The above refers more especially to passenger travel, but practically the same method is followed in connection with freight, both package and box freight, including milk, garden truck, etc., also mail, although the latter is not generally of great financial value, but policy may make it desirable.

Express matter and so-called package freight can usually be carried either in a special compartment of a regular car or in a special express car similar in general make-up to the passenger car used on the road, and, in either case, can be handled without interfering with the regular schedule and without any extraordinary demands for power. Bulk freight, on the other hand, to be profitable must be handled in fairly large quantities, and this requires the operation of train units of several cars. If such trains are run in the day time when the regular passenger traffic is on the road, it necessarily interferes more or less with the regularity of the passenger schedule, as such trains move at slower speeds than the passenger trains. In addition, such trains demand a large amount of power, consequently require a considerable addition to the power house, and also make it necessary to install sub-stations of such capacity as are required for one or more freight trains in addition to the regular load due to passenger cars. If there is a sufficient number of freight trains on the road to keep the additional machinery in the sub-stations reasonably well loaded this is not objectionable, but, on the other hand, if but one or two trains are on the road at a time it necessitates the installation of large capacity sub-stations, and consequently light average load and power efficiency.

In some cases it is possible to haul the freight during the night when the passenger service is either partially or entirely discontinued, and in such cases it may be possible to avoid the installation of additional sub-station machinery for freight service only. Even in this case, however, the freight haulage may involve the operation of several sub-stations to handle one or two trains, with a resulting very low load factor and very poor efficiency in the sub-station.

Another difficulty which arises in the hauling of heavy freight trains on an average interurban road, is that of delivering sufficient power to the train by means of the ordinary trolley wire. This difficulty does not apply in the case of the third-rail roads or in the case of the single-phase a. c. road.

Terminal facilities, railway connections and agreements, etc., are of great importance.

Where bulk freight is to be handled in considerable quantities on an electric road, it is just as necessary to keep down to a low grade as in the case of the steam road. The coefficient of tractive resistance in the case of a 10-car freight train at 15 m. p. h. and on level track is only some 7 or 8 lbs. per ton; where, on the other hand, each 1 per cent of grade adds 20 lbs. per ton; that is, on a 1 per cent grade the tractive resistance is perhaps 27 lbs. per ton, or nearly four times as great as that on a level track. Freight service, therefore, demands low grades so as to keep down the cost of locomotives, of power house, sub-station, and line equipment.

Having predetermined the obtainable traffic, the next step is to decide as to the traffic facilities which must be furnished for the anticipated business. Undoubtedly a map has been available from the start, and the general location of the proposed road has been marked thereon, from which distances between the principal points have been ascertained. The specialist also has gone over the route and is fairly well informed as to the physical conditions, and, in a general way, the most desirable locations, both in the country and in the cities and towns, also the practicability of obtaining such locations. In fact, he is quite well informed, not only as to the general situation, but also as to the business situation, probable character of franchises obtainable, legal conditions, etc. If the country is reasonably level he is able to approximate the cost of the grade, has ascertained the probable length of bridges required, and from the maps obtained distances with sufficient accuracy for a preliminary study. If the country is rather rough a topographical survey is exceedingly helpful, and quite frequently can be obtained from the United States Geological Survey. In some cases it is desirable to make at least a preliminary survey before the proposition has proceeded very far, but in many cases this is not only unnecessary, but actually inadvisable, as it necessarily indicates the most probable route and frequently increases the cost of right of way. A time must arrive when the location becomes evident, but there are methods of procedure which minimize the tendency to increase the cost of the right of way which practically always follows such publicity. In most cases the country population desires the road, but each owner of land desires to designate the exact location, which may be to avoid moving the farmers' house or barn, or passing between such buildings, which, of course, is natural, or may be to place it on the property immediately across from his home and belonging to his neighbor. As soon as he feels sure that the road will be accessible to him, he "stiffens up," whereas frequently he would rather give the right of way than not have the road. This is human nature, and he is no different from the rest of us. The statement is merely given as an example of the points which experience proves must be taken into consideration at every step in connection with a proposed road.

Having, as before stated, a preliminary map and possibly a profile of the route, train schedules and train sheets are prepared in order to ascertain the approximate time of the runs of the various classes of trains (each of which may consist of one or more cars), and which are of importance in determining the num-

ber of cars required, the motor equipment for each car, the amount of power required, the location of sub-stations, and other matters. Of course, at this time such schedules and train sheets are of a preliminary character, and are liable to modification after a final map and profile have been obtained, and also numerous other matters have been definitely decided, but a competent man will prepare the preliminary schedule with a very close approximation to the final ones.

Some of the questions which will arise at this point are as follows:

With a preliminary map which shows the length of the road, and the length of the run in cities, towns and country, including the length in the principal terminal cities, and knowing that it is desirable that passenger cars should be operated at regular intervals, starting from terminal points, preferably on the hour, half-hour or quarter-hours; also knowing that the cost of train crews is one of the principal expenses, and consequently that the lay-overs at the ends of the route should not be greater than necessary for unloading and loading the cars, with sufficient allowance for delays in reaching such terminal points, and not forgetting that increased speed necessitates, for any given size and weight of car, greater capacity of motors, and also increased cost of the power equipment, including motors, sub-station and power-house machinery; also knowing that the runs in the cities and towns are under city regulations as to speed, and therefore cannot be increased by higher speed motors; also realizing that increased stops in the country materially decrease schedule speed, the proposition is to so combine all these factors as to obtain the best net result.

In such study, consideration must also be given to grades, grade crossings with other railways, and, to some extent, of highways, also in some cases the service given by competing roads, either steam or electric. As an example: Suppose that the preliminary schedule results in 2 hours being required for the run. Evidently it is desirable that by some means the time should be reduced to 1 hour and 40 minutes. Such reduction may be obtained by reducing the length of the runs in the towns, or by lessening the number of country stops, both of which seriously affect the schedule speed, or possibly by reducing the length of the route which may require increased cost out of proportion to the benefit, or by reducing the grades, which also may cost more than proportionately to the benefit. It is a fact that the income per capita in the country will generally be greater than from that in towns, but an effort to obtain every dollar possible from the country may be exceedingly poor economy. It might be considered that this is a matter of policy to be determined by the management, but it is of vital importance in connection with the design, if the design is to be such as will give the best returns per dollar invested.

The consideration of the route may start with the principal terminal city, and it is of great importance to have the terminal station in such city well located relative to the retail district, which is generally also the amusement center.

Generally interurban roads entering a city of any considerable size use the tracks of the local street car system, but sometimes it is possible to obtain an independent entrance, and, when the financial condition warrants it, this is preferable. It is, however, seldom warranted unless the anticipated travel is very considerable, and, of course, is materially affected by the cost of construction required in the city, including the cost per mile and total mileage, which includes the first cost and the maintenance of street paving, sprinkling charges, if any, etc., and city taxes. It also depends upon what arrangement which can be made with the local company for operation over its tracks.

In a general way the shorter the route in the city, or more correctly, the less the time of the run in the city, the better for the interurban railway.

The foregoing materially depends upon the frequency of service given by any competing steam road and by the time required between the station of the steam road and the retail center, not only in the principal terminal city, but also in the principal towns along the route. For example, on a proposition now in our office a large amount is being expended in order to reduce the time required in the principal city, and because the competitive steam railway service is very frequent, there being two competitive steam roads, each operating trains hourly. In another case, where the competition is four or five trains each way daily, and most of such trains are through trains, generally 1 or 2 hours late and only stopping at two points along the route other than the principal city, it is not advisable to make large expenditures in order to save a small amount of time.

Another point, somewhat allied to the foregoing, is the location of the road in cities and towns along the route. The receipts of an interurban electric railway depend largely upon the accessibility of its cars and its frequent service, but, on the other hand, accessibility in the cities and towns generally means somewhat increased first cost, also a longer time for the run. If freight cars are to be handled it means considerable additional trackage for the freight line.

In addition to the foregoing the recent development of the alternating-current motor system makes it desirable for such roads as use such system to keep on private right of way to as great an extent as possible, and when in cities and towns to use only such streets as will allow the use of high-voltage trolley. As a matter of fact, high-voltage trolley is now used in some towns of considerable size and on roads passing through the heart of same, but it is hardly probable that this will be permitted in all towns. In some locations it may not be found advisable even if permitted.

Having made a preliminary location and ascertained the distances in the cities, towns and country; having considered that a certain sized passenger car operating on a certain headway will give the best service, and on the presumption that, all things considered, a certain grade will be most economical, a train schedule is prepared showing the time of the run for passenger service. There will generally be two train schedules, one for express and the other for local service.

It is advisable that the trains should follow at regular intervals, which intervals, however, may be varied at different times of the day and at different seasons, but the trains should always start from one end on the hour, and when more frequent service is desired half-hourly and quarter-hourly. The time of leaving the other end should also be on the hour, or at some regular division, such as the half, or quarter-hour. It is evidently necessary, therefore, to provide motors which will make such speed as is required to give a schedule enabling a car to make the run one way and provide at the end of such run sufficient time for lay-over, so that it can unload and load with sufficient leeway, and, in case of delays, it will still start out on the return run on the schedule time. The time of the run in the principal city is dependent upon the schedule time of the city cars if the local company's track be used, or upon local ordinances and conditions if the interurban company has its own track. The schedule speed in the principal terminal city will probably be approximately 8 or 12 m. p. h., being somewhat less in the congested portion of the city run, and possibly slightly greater in the suburbs.

The same conditions apply to the runs in the towns along the route, although generally to a less degree, but in any case the schedule in cities and towns is based on local conditions, and not upon the speed obtainable by the motors.

The speed on the country run which, for modern roads is generally on private right of way, depends upon the grade, and, for any given weight of cars, upon the power of the motors, and, of course, upon the maintenance of the voltage. The schedule speed depends upon the above and also upon the number of stops.

The length of lay-over is often of material bearing on the question of size of motors. Sometimes by allowing a car to lay over at one or both ends of the run for 15 or 30 minutes it is possible to use a smaller motor than would otherwise be necessary. Such lay-over is seldom objectionable, as it gives an opportunity to sweep out and clean up a car, and frequently when the car house is at one end of the terminal, it is possible to provide such a lay-over without any additional expense. By so doing a material saving can be made on the first cost of all the car equipments, and may more than offset the first cost of the extra cars and equipments which may be required, and the repair and depreciation may be less. Actually it is seldom that additional cars would have to be purchased, as there are always supposed to be enough cars for special occasions.

The number of stops made by a car has a very decided effect upon the size of motor necessary to drive it, and with any given schedule and car the less the number of stops the smaller and cheaper the motor equipment.

Taking a given car geared to a maximum speed of 40 m. p. h., with eight stops per mile, the possible schedule speed is less than 10 m. p. h. With four stops per mile the possible schedule is less than 15 m. p. h. With two stops per mile the schedule speed is about 20 m. p. h., and with one stop per mile the schedule speed is about 26 m. p. h. On the other hand, with one stop in 8 miles a schedule speed of 34 m. p. h. can be made. Of course, the above is based on having a level and straight road.

Had the same car been equipped with motors geared to but 30 m. p. h., it would have been made with eight stops per mile, a

schedule speed of 8 m. p. h., which is practically the same as before; with four stops per mile it would have made a schedule of 13 m. p. h.; with two stops per mile a schedule of 17 m. p. h. The schedule will not only be practically as good as that made with higher gearing, but also the motor equipment can be decidedly smaller and cheaper, and the fluctuation of load at the power house will be much smaller than that resulting from the higher speed car.

Some roads have larger cars than are most economical for the service, and the use of smaller cars is of additional value by reducing the size of motor equipment required, and by lessening the fluctuation of load at the power house. Smaller cars also permit of lighter track construction, small sub-stations, and, in fact, lower costs generally. On the other hand, if travel is great enough so that a small car cannot handle the traffic, then two cars can be run on half of the headway with but little more cost, except as to train crews, than for the operation of one large car, with the result of much better service, with consequently increased income, and with comparatively small increase in the power house and sub-station equipment required.

If, for example, a preliminary estimate shows that it will take 2 hours to make the run over the proposed road, 40 miles in length outside of the principal city, and possibly 3 miles therein, it is evident that a time-table based on cars leaving such end of the route on the hour will necessitate the car leaving at the same time as it arrives, in other words, there is no provision for layover. It is evidently necessary to lessen the time of the run, and this must be done by lessening the time of the run in the cities and towns, which presumably can only be done by lessening the length of the run in same, especially the run in the congested district, or by increasing the speed of the cars, requiring, therefore, more powerful motors, or by reducing the number of country stops, which necessitates a consideration of the effect of same on travel, or by reducing the grades, and unless the grades are considerable, the amount of the reduction, as far as time is concerned, will generally be found quite small and not comparable with lessening the number of stops. For example: In one case we prepared a preliminary estimate of the cost of the grading required to obtain a maximum 1, 1½ and 2 per cent grade through a country rolling the entire distances, and the time which would have been saved by reducing from 2 per cent to 1 per cent was not greater than a reasonable allowance for time lost in the principal city on account of delays in the congested district; whereas, the additional cost required for the reduction of grade would be very considerable.

When considering freight service the principal consideration is the train load, schedule speed within considerable limits not being of great importance, but the load which the electric locomotive can haul, requiring the service of only one train crew, is of vital importance. In connection with passenger service it is of great importance to make such schedule as will use the time of the train crews to the greatest advantage, as the cost of their time is one of the principal items of operating expense.

Having obtained a general view of the proposition, especially as to its general character and the approximate amount of traffic, and having from a map obtained distances, and from examination of a final or a preliminary profile, ascertained approximate grades and the amount of grading construction, the investigator is in a position to decide as to the general type of road, the system to be used (a. c. or d. c. motors), and to prepare a preliminary estimate of first cost, cost of operation, and, most important of all, net income.

The preliminary report informs the projector as to whether or not the proposition has such merit as to warrant its construction, and if it is not warranted, then the sooner such fact is ascertained the less the time and money which will be wasted. If, however, it is warranted, then successful operation depends to a large degree upon the design being that best suited to the conditions; such amount of money being available as required in order to obtain the best net results, and its construction to be so supervised as to assure that the contracts are lived up to.

Some interurban electric railroads should never have been constructed, as under no conditions were they warranted. Others have been improperly designed, considered from the standpoint of obtaining the best net results. In some cases the construction has been of too expensive a character, and in other cases there has not been sufficient money expended on the construction. Other roads have not been properly maintained, and still other roads have not been properly managed. Of course, some roads come under more than one of the above classes. If, however, a road is justified, then its success, exclusive of its financing, depends upon obtaining the best location, proper design for the conditions, proper construction, competent operation. It is noted that the first three are dependent upon the expert adviser, and that the result which can be obtained by the fourth is largely affected by the attention given to the first three. Moreover, the first three are practically unchangeable after the road is constructed, whereas, the fourth, if in incompetent hands, can be changed.

If the project is warranted then the maximum degree of success in financing depends largely upon the proper presentation of the proposition. There should be a short, clear and concise statement as to the territory served, the estimated first cost, and the gross and net income, followed by such detailed estimates, statements and other information as experience indicates is desired by financial houses.

When it is decided to construct the road, a location survey is made, which may or may not have been preceded by a preliminary survey. The latter may have been, and frequently is, made prior to the preparation of the report submitted as the basis of the financing. In fact sometimes a location survey is made prior to such time.

The object of a preliminary survey is to ascertain distances more accurately than are generally obtainable from published maps, and also to more closely approximate the grades and amount of grading than can be ascertained merely by going over the route, although, as before stated, if the country is reasonably level, an expert in such work can quite closely approximate the amount of grading.

Preliminary surveys of alternative routes are frequently made and are useful for comparison of length of routes, cost of construction, comparative value of route from earning basis, and are sometimes of assistance in obtaining rights of way at minimum cost.

In connection with the foregoing it might be noted that promoters sometimes make statements and promises and also obtain rights of way and franchises which unnecessarily add to the cost of construction, or of operation, or both. As, for example, agreeing that the power house, or car house, or both, shall be located within or adjacent to a certain town. Placing same within the corporated limits may add to the taxes, and in other respects it may be undesirable; as, for example, one franchise which came to our office required a power house to be in a certain city, and the water would have to be obtained either from the city or pumped from deep wells. In another case local service in one small city was required with such frequency of service as could not possibly be remunerative. In other cases the rights of way in the country have been obtained with special reference to the cost of such right of way, or to favor some land owner, and without taking into consideration the fact that the saving of one mile of single-track road and the line work for same will generally save $12,000 to $15,000 in first cost, save maintenance and depreciation of omitted track and pole line, lessen the time of the run and the power required for same, and altogether be of such benefit as to be worth $20,000, or more, which amount would generally buy a considerable amount of private right of way in the country.

As the civil and mechanical electrical engineering departments are closely related, it is necessary to decide as to what grades will be most economical. Reducing the grades adds to first cost and also adds to the maximum power required, and consequently, unless storage batteries are used, reducing the ratio of average power to maximum power, and such reduction increases the cost of fuel. The effect of grades on passenger schedules must be noted and also on the load which the freight locomotives can haul. In a general way, it is evident that the more frequent the service and the heavier the trains, the greater the amount which can be most economically expended in the reduction of grades, and as a future improvement of grade will require a greater expenditure than if such a grade were established at the start, it is wise to give consideration to the somewhat distant future.

Having decided as to the grades, the train schedules and the motor equipments, the next point is to provide for the furnishing of power to the cars. Presumably decision has been reached as to the system to be used, also as to the most desirable location of the power house and sub-stations. The next point is to determine definitely the general character of the machinery for same and the rated capacity and number of the various units.

Each sub-station must have sufficient capacity for maximum demand, and judgment must be exercised as to whether to provide any reserve capacity in excess of such maximum. The number of units must be such as will furnish power for the average load, even though one unit be crippled, and also will enable the units in operation at any one time to operate as nearly

as possible at their rated capacity. It is also desirable not to have an excessive number of units, as for a definite total capacity this increases the first cost.

The general proposition as to the design of the power house is the same as above stated for sub-stations, but on the basis that such power house is to be a steam plant, careful study must be made of the cost and character of fuel, the required draft for such fuel, the best ratio of grate to heating surface; and if compound engines are used, the best ratio of cylinder diameters in order to obtain the maximum economy under operating conditions, taking into account steam pressure, superheat, if any, and the most economical vacuum.

It will be noted that the preceding necessitates a predetermination of the load curve, the probable momentary and short period of fluctuations, and, as before stated, these are affected by the grades, the weight, maximum speed, and schedule speed of the cars, and by the train schedules, all of which indicates the close interrelation of the various factors entering into the problem of so designing an interurban electric railway as to obtain the maximum rate of dividends.

The next step is to so supervise construction as to assure that the contracts are fulfilled. When construction is completed and accepted, then the road is turned over to the operating department, and on the basis that such department is competent, the results obtained depend very largely upon the character of the work which has preceded. A comparatively few extra dollars expended in assuring the best possible design and construction will probably save many times the interest on such additional expenditure, and there is no investment which pays as large dividents as that which can wisely be expended in order to "start right."

APPENDIX "A"

Since the single-phase a. c. motor has become an accepted fact, it is now in some cases advisable to consider plans and to make estimates of cost based both on d. c. and on a. c. equipment, and such estimates include both first cost and operating expense as well as the general adaptability of each system to the road in question, and a few words on this subject may not be amiss.

The general characteristics of the single-phase a. c. road, as compared with d. c., are low first cost of line and sub-station equipment, high first cost of car motor equipment, and ability to deliver power either to many small units or to a few large units, and in either small or large blocks. The characteristics of the d. c. equipment are high first cost of equipment of sub-stations and line, low cost of car equipment, and considerable cost for sub-station attendants, and ability to deliver power to a considerable number of units in small blocks, but requiring much greater investment than d. c. when awarded, and it is unnecessary to state that there is considerable opportunity for saving money in awarding contracts.

After all plans and specifications are prepared, the contracts are required to deliver large quantities of power to a small number of units.

As a result the a. c. motor system is more especially adapted to the interurban roads where first cost must be the minimum and where the number of cars operating is comparatively small, and also to the operation of trunk lines, freight roads, etc., where there are a small number of heavy trains to be moved, and therefore, in a general way, for "interurban roads in sparsely settled districts." On the other hand, the d. c. equipment is preferable for the city road, the elevated road, and suburban roads with heavy traffic and where the number of trains is large.

The interurban road which is equipped with the single-phase trolley is in a position to handle freight in large units to much better advantage than the road having d. c. equipment, as it is not limited as to the amount of power which a trolley wheel can take from the wire, but only as to the maximum load which the sub-station can carry; and in this case the sub-station equipment is comparatively cheap, it is possible to have a sufficient sub-station capacity to handle heavy freight in addition to the passenger service.

APPENDIX "B"

Some Convenient Tables and Suggestions Relative to Tables and Curves

Engineers' hand-books are of great value, but every engineer also has data of his own collecting, which he tabulates and charts in such manner as is most applicable to his work, and most convenient for him. The following tables and curves may be found convenient, and suggestion is made relative to others which are convenient, but are not presented for the reason that they refer to cost, and, like other statistics, would be liable to be incorrectly used.

TABLE NO. 1

Convenient for Calculating Trolley and Feeder Drop

Interurban roads usually have two trolley wires, and as a 300 M. C. M. feeder (insulated) is the largest solid (not stranded) wire which can be readily handled, it is quite frequently used, and therefore tabulated.

TABLE No. 1.

$$\text{VOLTAGE DROP IN CONDUCTORS} = \frac{11 \times A \times L}{C.M.}$$

MILES	TWO IN MULTIPLE—TROLLEYS. (5350 ft. per mile.)														SINGLE. (5400 ft. per mile.)						
	No. 00 TROLLEY.							No. 000 TROLLEY.							300 M. FEEDER.						
	Amperes.							Amperes.							Amperes.						
	50.	100.	150.	200.	250.	300.	450.	50.	100.	150.	200.	250.	300.	450.	50.	100.	150.	200.	250.	300.	450.
½	5.5	11	16.5	22	27.5	33	50	5	9	13	18	22	27	39	5	10	15	20	25	30	45
1	11	22	33	44	55	66	99	9	18	26	35	44	53	79	10	20	30	40	50	60	90
2	22	44	66	88	110	152	198	18	35	53	70	88	105	158	20	40	60	80	100	120	180
3	33	66	99	132	165	198	297	27	53	78	105	132	158	236	30	60	90	120	150	180	270
4	44	88	132	176	220	264	396	35	70	105	140	175	210	315	40	80	120	160	200	240	360
5	55	110	165	220	275	330	495	44	88	131	175	219	263	394	50	100	150	200	250	300	450
6	66	132	198	264	330	396	594	53	105	158	210	263	315	473	60	120	180	240	300	360	540
7	77	155	231	309	385	462	694	62	123	184	245	307	368	552	70	140	210	280	350	420	630
8	88	177	264	354	441	528	795	70	140	210	280	350	420	630	80	160	240	320	400	480	720
9	99	198	297	397	394	594	893	79	158	236	315	394	473	709	90	180	270	360	450	540	810
10	110	221	331	442	552	663	993	88	175	263	351	438	526	788	100	200	300	400	500	600	900
11	121	242	363	....	....	....	....	97	194	....	....	....	....	....	110	220	330	440	550	660	990
12	132	264	....	....	....	....	....	106	....	....	....	....	....	....	120	240	360	480	600	720	....
13	143	286	....	....	....	....	....	116	....	....	....	....	....	....	130	260	390	520	650	780	....

Allowance is made for sag.

Resistance is based on "hard-drawn wire."

Require no explanation, except that for loss other than 10 per cent the cross-section and weight and cost will be inversely proportional. Tables which, for the reason stated, are not presented are as follows:

Cost of pole lines, various types. Cost of sub-stations, various sizes and numbers, and type of statics, and size and number of rotaries, H. T. lightning arresters, wiring, buildings.

Cost of power houses of various types complete and per kilowatt.

In some cases curves are more convenient for calculation than tables, but not always.

For comparison of results curves are nearly always preferable.

CURVE NO. 1

Size of wire and weight (all wires) per mile for transmission lines.

Given the transmission voltage, per cent loss, and kilowatts and distance, look in table under column giving the transmission voltage, find nearest per cent to that desired; look in left-hand column for scale reference, and find the intersection of such references in the curves.

For example, 20,000 V.—5 per cent—20 miles and 750 kilowatts. Under 20,000—5 per cent is given by A-3, and by B-2, and by C-1, and which reference is the easiest to follow depends upon the miles and the kilowatts, "A" being for the least and "D" for the greatest kilowatts, and 1 for the least and 3 for the greatest mileage.

For kilowatts=750 and if used A-3, follow the horizontal line

opposite 750 in "A" column, until over 20 in "3" horizontal line.

Of course the other references give the same result.

APPENDIX "C"

The following table gives the average kilowatt-hours per car-mile on various interurban electric railroads. The power consumption given is at the car. All lay-over time is excluded from the schedule speeds.

Roads A, B, C, and D operate from the same large terminal city. Roads D and E operate from other cities. Roads A and E are in the Central West. Road F is in the Southwest.

The car equipment used on all these roads except H is of approximately the same character, the cars being from 42 to 45 ft. over all and each equipped with four 50-hp motors. H is

"A."—The time saved per train and total of all trains, and what it is worth, if anything.

"B."—The total energy saved, not on a pro-rata basis, but on the basis of the additional cost for the additional energy.

"C."—Effect of reduction in grade on capacity of motors; in some cases this may change size of motors, or size and weight of car most advisable.

"D"—Effect of fluctuation of load, and on maximum power required in sub-stations and in power house. This may affect capacity and number of units. In each case there will be other factors.

Suppose the answer to "A" is: Time saved per passenger train for reduction of 3 per cent to 1 per cent grade—10 minutes.

What is it worth?

TABLE No. 2.—CIRCULAR MILS OF COPPER CONDUCTORS.

Based on 20,000 Volts, 3 Phase, 90% Power Factor, 10% Loss in Transmission. 1 Mile Feeder = 5,400 Feet.

$$C.M. = \frac{D \times W}{P \times E^2} \times K = \frac{(5400 \times 100) \times (2{,}000{,}000)}{(10) \times (20{,}000)^2} \times 1330 = 359{,}100.$$

K. W.	Distance of Transmission in Miles.									
	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.
100	1,796	3,591	5,387	7,182	8,978	10,773	12,568	14,364	16,160	17,955
200	3,591	7,182	10,773	14,364	17,955	21,546	25,137	28,728	32,319	35,910
300	5,387	10,773	16,160	21,546	26,932	32,319	37,705	43,092	48,478	53,865
400	7,182	14,364	21,546	28,728	35,910	43,092	50,274	57,456	64,638	71,820
500	8,978	17,955	26,933	35,910	44,888	53,865	60,843	71,820	80,798	89,775
600	10,773	21,546	32,319	43,092	53,865	64,638	75,411	86,184	96,957	107,730
800	14,364	28,728	43,092	57,456	71,820	86,184	100,548	114,912	129,276	143,640
1000	17,955	35,910	53,866	71,820	89,775	107,730	125,685	143,640	161,595	179,550
1200	21,546	43,092	64,638	86,180	107,730	129,276	150,822	172,368	193,914	215,460
1500	26,932	53,865	80,798	107,730	134,662	161,595	188,528	215,460	242,392	269,325
2000	35,910	71,820	107,730	143,640	179,550	215,460	215,370	287,280	323,190	359,100

TABLE No. 3.—COST OF CONDUCTORS (IN DOLLARS).

Based on Copper at 20 cts. per pound. From Table No. 2.

K. W.	Distance of Transmission in Feet.									
	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.
100	.....	.....	.....	.....	.....	.....	.....	11556	14611	18000
200	.....	.....	.....	.....	9022	13000	17667	23056	29222	36090
300	.....	.....	.....	8667	13571	19500	26544	34667	43889	54134
400	.....	.....	6500	11555	18040	26000	35344	46111	58444	72179
500	.....	3611	8111	14444	22555	32444	44167	57722	73050	40224
600	.....	4333	9744	17333	27055	38944	53056	69222	87666	108269
800	1445	5777	13000	23111	36111	51944	70778	92333	116778	144358
1000	1778	7222	16222	28889	45111	65000	88444	115555	146111	180448
1200	2167	8067	19489	34666	54111	77800	106111	138333	175111	216338
1500	2722	10833	24333	43333	67778	97444	132678	173333	219322	270672
2000	3611	14444	32444	57778	90222	130000	176667	231111	292222	360896

$$3 \times \frac{359100}{300000} \times 5028 \times 100 \times \$0.20 = \$360{,}895.06.$$

from the test runs made by the Electric Railway Test Commission of the St. Louis Exposition on the Union Traction Company (Indiana) system.

The figures may have some interest, but are presented to show the quite wide variation and the inaccuracy of accepting averages. A knowledge of the profile, schedules, maximum, and average speeds, number of stops, ratio of motor gearing, voltage on line, etc., explains the variations, but without such knowledge the application of any of the results, or their average, would be misleading, and the energy which will be required can be more accurately predetermined for any given road by other methods.

APPENDIX D

Examples of some points referred to in the main article.

Suppose the road is 50 miles long and is to be designed for passenger and express service, but not for freight, at least to any considerable degree.

Suppose that a 5 per cent maximum ruling grade would cost a certain amount, and that to reduce it to 2 per cent without change of location would cost $250,000 additional, and to 1 per cent would cost an additional $500,000, as compared with the 2 per cent, or $750,000 as compared with 3 per cent.

What should be considered in evaluating the problem?

TABLE No. 4.—NUMBER OF WIRES, AND SIZE, B. & S. GAGE.

Nearest Size Taken from Circ. Mil. Table No. 2. Preference given to larger sizes and even numbers.

KW.	Distance of Transmission in Miles.									
	10.	20.	30.	40.	50.	60.	70.	80.	90.	100.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
100	.....	.....	.....	.....	.....	.....	.....	3—6	3—6	3—6
200	.....	.....	.....	.....	3—6	3—6	3—6	3—6	3—5	3—4
300	.....	.....	.....	3—6	3—6	3—5	3—4	3—4	3—3	3—3
400	.....	.....	3—6	3—6	3—4	3—4	3—3	3—2	3—2	3—2
500	.....	.....	3—6	3—4	3—4	3—3	3—2	3—1	3—1	3—0
600	.....	3—6	3—5	3—4	3—3	3—2	3—1	3—1	3—0	3—0
800	.....	3—5	3—4	3—2	3—1	3—1	3—0	3—00	3—00	3—00
1000	.....	3—4	3—3	3—1	3—0	3—0	3—00	6—1	6—1	6—0
1200	3—6	3—4	3—2	3—0	3—0	3—00	6—1	6—1	6—0	6—0
1500	3—6	3—3	3—1	3—0	3—00	6—1	6—0	6—0	6—00	9—0
2000	3—4	3—1	3—0	6—1	6—0	6—1	9—1	9—0	9—0	9—00

APPENDIX "C."

ROADS.	Schedule Speed M. P. H.	Kw-hours Per Car Mile.	Watt Hours Per Ton Mile.	Stops Per Mile on Test Runs.	Notes.
A	26.2	2.88	.....	.85	Interurban runs only.
A	10.	2.11	.....	.....	City.
A	18.1	2.53	.....	.....	Entire run.
B	20.5	2.85	.....	1.41	Interurban run only.
B	9.5	2.27	.....	.....	City run only.
B	15.2	2.60	.....	.....	Entire run.
C	20.4	2.18	.....	.70	Interurban run only.
C	7.9	3.36	.....	.....	City run only.
C	10.5	3.48	.....	.....	City run only.
C	15.1	2.50	.....	.....	Entire run.
D	20.6	2.18	.....	.56	Interurban run only.
D	10.1	2.18	.....	.....	City run only.
D	18.1	2.18	.....	.....	Entire run.
E	20.6	2.16	.....	.....	Interurban run only.
F	24.4	1.88	72.3	.54	Entire run.
G	23.2	2.49	91.75	.....	Entire run.
G	23.3	2.08	78.75	.76	Entire run.
G	29.1	1.97	74.	.3	Interurban run.
G	19.3	*2.71	63.75	.4	Entire run. Motor and trailer.
H	28.84	3.34	84.4	**.2	Entire run.
H	26.8	*4.58	73.8	**.19	Entire run. Motor and trailer.

* Kw-hours per train mile, motor and trailer.
** Stops in country—stops in city were .97 and .92 respectively.

If the result is that the run can be reduced from two hours to one hour and fifty minutes, with ten minutes lay-over for crew (whether or not motor car lay-over is longer), and that in no other way could such result be obtained, then it is worth considerable, and because of the resulting saving in time of train crews.

The saving in time of run may also have some commercial value, but this depends upon the character of the competition, and reliable services and comfortable cars with smooth riding are more important for obtaining business than a saving of 8 per cent of the time.

Suppose an average daily headway of, hourly—fifteen hours daily; one-half hourly—five hours daily. The result in time of train crews lost would be the same as hourly headway for twenty hours daily.

If each crew had to lay over one hour out of each trip at each end of the line, the time wasted would be 33 1-3 per cent, or, in other words, there would be at all times two trains waiting—one at each end, which at 45 cents per hour per crew is $18 per day and $6,570 per year, which is interest at 6 per cent on $110,000. Even for this extreme case the lessened grade would not pay at the cost stated.

"B."—Suppose the energy saved to be, at the power house, 5 kilowatt-hours per car-mile—total car miles annually 912,500
Total kilowatt-hours saved 456,250
If additional cost per kilowatt-hour is .5 ..... $2,281.25
Is 6 per cent on $8,000.000

The additional cost for the additional energy is mainly for the fuel, but if the range of fluctuations is materially increased by the greater grade, then the result may seriously affect the entire output, possibly in some cases increasing the entire fuel bill 10 per cent or 20 per cent or more.

"C."—For the case under consideration it is not probable that there would be any actual change in size of motors, but there would be a tendency towards a lessened depreciation of motors.

"D."—If the additional fluctuations caused by increased grades should make necessary 1000-kw sub-station apparatus, at $25 per kilowatt (for additional, not pro rata, capacity), and 500 kw additional for the power house, at $80 per kilowatt additional, then the total increased cost on such account would be $65,000.

As a matter of fact, apparatus cannot be obtained in capacities having small differences, and the question frequently is, shall the marginal capacity or safety be kept down or the next larger size be installed? The former increases efficiency of operation, also depreciation, the latter first cost, ability to handle maximum traffic, and fuel per kilowatt.

The totals above obtained are:

A $110,000
B 38,000
C 65,000

Total $213,000

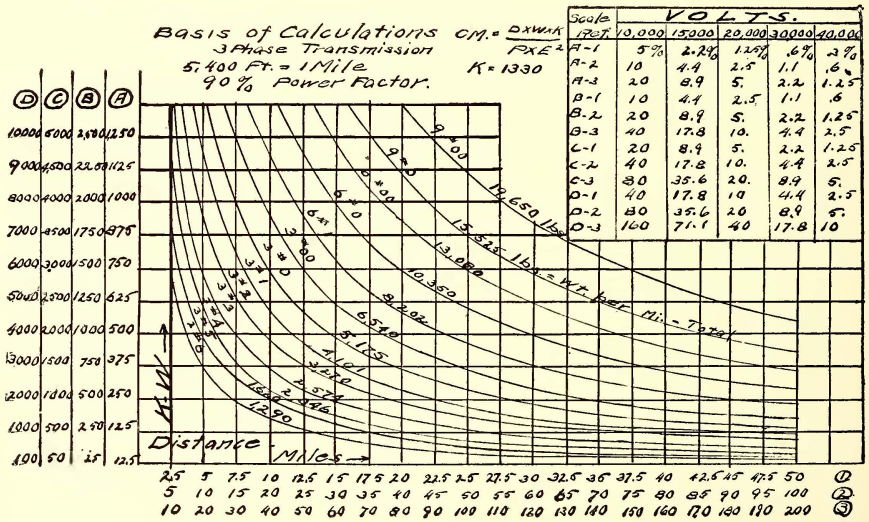


CHART NO. 1.—APPENDIX "B"

Being the equivalent value of the reduction in grade, or approximately $4,000 per mile of road.

Suppose "A" is excessive and take one-half $55,000
Suppose "B" not enough and double 76,000
Suppose "C" not changed 65,000
And also suppose that the lessened average efficiency increases cost of all power 2,000

Total $198,000

But there are nearly always additional factors to be considered, and the basis taken for each of the above tends to favor reduction more than would usually be the case in practice for passenger interurban railroads, but even the total of the above would not be advisable for the stated cost of the reduction of grades, but the more frequent the services the greater the amount which

should be expended to reduce grades along the route.

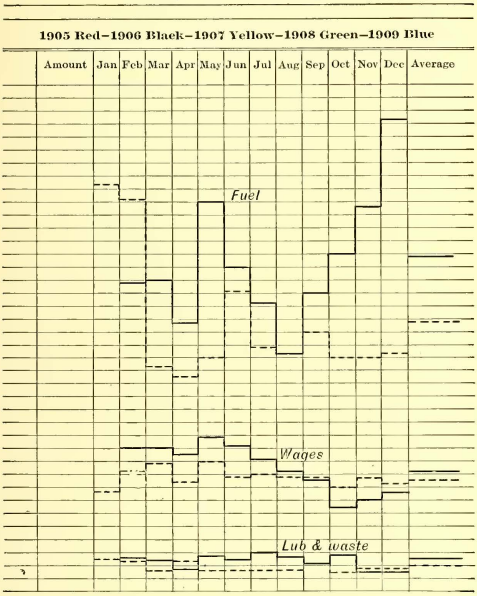
This example also indicates the close connection between the civil and electrical engineering departments, although too often it is not taken into account.

As stated in the main article, the effect of grade on freight trains is more marked than for passenger service.

APPENDIX "E"

Recording and Analyzing Statistics Relative to Operation

Statistics are naturally recorded in tabular form, but for the purpose of comparison it is generally preferable to chart the results, and by so doing variations from month to month and year to year are much more noticeable, both as to character and degree.



The size and ruling of the paper used for charts are immaterial, but we find it convenient to use loose sheets 4 ins. x 7 ins., and which file in a pocket notebook and are ruled as per sample. The figures placed in the column headed "amount" depend upon the values of the data chartered. If there is only a difference of a few thousand dollars between maximum and minimum, then the difference between each horizontal line can be $500 or $1,000. For example: "gross earnings" will probably necessitate a large difference, whereas for oil and waste and some other items, which do not have a great variation, the difference between horizontal lines need not be more than $100.

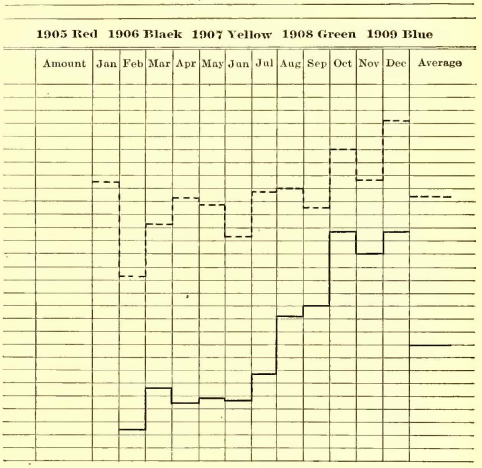
Based on the books being kept in accordance with the standard of the American Street and Interurban Railway Accountants' Association, we chart the various items so listed and also some additional items, and also consolidate some of the items into one chart. For example: we chart car mileage, total and divisions, if any, kilowatt-hours per car-mile, power-house and substation output in kilowatt-hours, cost of same, etc.

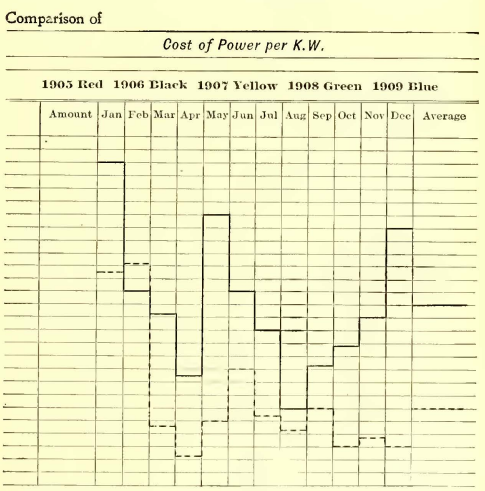
The above are charted from month to month, and also the average for the year. Different colored inks are used for different years, although in the samples herein submitted different character of line is used in order to avoid color printing. Chart No. 1 is presented as a typical example of the use of the chart. Supposing the full line to represent the income for one year and the dotted line the income for the next year, then some of the questions would be as follows:

Referring to the first year it would be noted that February is less than January, and the question would be "why was such the case?" This would be partly answered by the fact that it is a shorter month and also that there is generally considerable holiday riding in January. Reference would also be made to the chart showing "car mileage" and "receipts per car mile," and if a record is kept on weather conditions, same would also be referred to.

The chart shows a gradual increase during the summer until September is reached. In each case an effort should be made to ascertain the reason for the increase, and when September is reached the reason for the decrease. The latter is also true as to November.

When the second year is charted a reason for the change from month to month should be ascertained and also the reason for any variation in amount from character of monthly change in the preceding year or years.



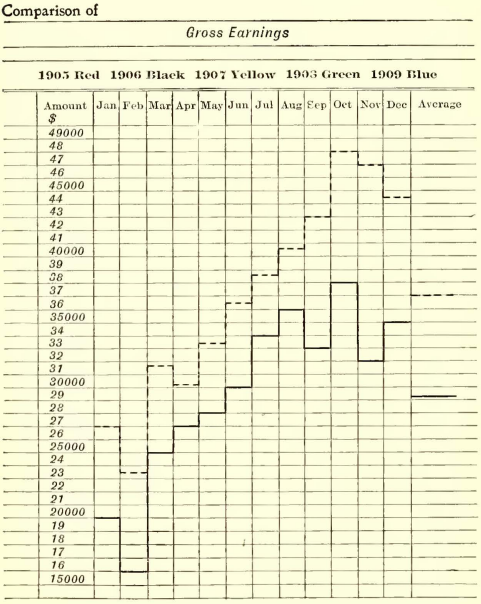


Similar charts are made for operating expenses, net earnings, fixed charges and net profits. Charts are also made for each item, or, if preferred, in some cases groups of items, tabulated in accordance with the standard of the Accountants' Association. In order to obtain full value from such charts it is necessary to compare some of the tables and charts. For example: Take the item of "operation of power plant." It is undoubtedly desirable to

know the total, but from the standpoint of analysis it is evidently also necessary to know "total per kw-hours delivered to the line, the cost per kilowatt," and the analysis of such latter cost, and also it is advisable to note the total car mileage, although in some cases, because of the various type of cars, the latter has little, if any, value.

In connection with the above, it should be noted that the power house cost per kw-hour should be based on the kilowatt delivered to the line, and any electrical energy delivered by exciters or used for motor-driven apparatus in the power house should not be included, and special attention is called to this because the latter method is sometimes used.

Evidently, if the cost of fuel per kw-hour increases, the reasons should be ascertained. It may be on account of poorer fuel, based on results per dollar, or it may be on account of lighter loads, or not maintaining the generators at as high a ratio of load to rating. Also it may be due to poorer firing, and in this connection a record of boiler feed water is of value. In connection with the last suggested possibility, it should be noted that unless such meters are frequently calibrated that the records may be misleading, and consequently worse than none, and this, to a greater or less degree, is true of all registering apparatus. The value of



recording apparatus can hardly be over-estimated if it is properly maintained and the records intelligently used, but in too many cases this is not true.

Nos. 2, 3 and 4 are typical charts of kilowatt output of power house, and they are for the same plant and years. It is evident that in consideration of same there was ample opportunity for careful study. The costs are not given and the zero line is not at the bottom of each page, but in a general way it will be noted that the output increase and the cost per unit for fuel and wages decreases.

We believe it to be evident that results can be much more readily compared on charts than by reference to tables.

A few words relative to an additional value of such charting and analyzing may be of interest. Our experience has been that managers and superintendents sometimes hesitate relative to the preparation of such charts and the analysis of same, undoubtedly fearing that in some way they will render themselves more liable to adverse criticism, and such may be the case if they are not properly carrying on their work. Sometimes the claim is made that they are doing the best they can, and such records and investigation merely require additional time without giving commensurate benefits. If, however, the charting and analyzing are made by independent parties who not only are confident but also are "big" enough and broad minded enough not to be controlled in their advice by those whom they may hit, the result is beneficial, not only to the railway company but also to the manager and the superintendent, and for the reason that if such men make improvements such fact is and should be called to the attention of the higher officers or the board of directors, and a statement of such character by an independent and specially qualified expert has much greater value than if made by the manager or superintendent. Another and very important point is that not infrequently the manager or superintendent is expected to produce impossible results. The means with which they are provided being insufficient for the purpose, and frequently any statements from them to such effect is considered as an excuse.

We also believe it to be a fact that a competent man, not too closely identified with the operation of possibly only one road, will not only have a broader view but will also make a more searching and well-balanced investigation of the conditions relative to an operating road than is generally possible for even an equally good man who is so close to the operation of the road that he will necessarily be more or less biased by its history, and who, because of constant attention to details and closeness to the work, has lost the perspective.

In conclusion, the writer advises indicating and registering apparatus, proper maintenance of same, complete records and tabulation and chartering of such records, and calls special attention to the fact that the value of all of same depends entirely upon the analysis of the results, and that the object of such analysis is to increase income, lessen operating expense, or both. In other words, to obtain maximum net income.

TICKETS AND RATES

BY F. W. COEN,
Secretary and Treasurer of the Lake Shore Electric Railway Company, Cleveland, Ohio

Since the early days of man the matter of transportation, whether covering shipment of merchandise or the handling of passengers, has been a great question, and one which has received much attention from all classes of people. During the past quarter of a century a great deal more attention has been given the subject than in previous years, this being especially true in this country. It is not difficult to find why this is the case.

This country during the past twenty-five years has seen wonderful development, and the transportation companies have been the forerunners of this development. In other words, the Western plains were practically of no use to mankind until the great railroads of the country began to extend their lines into this unimproved and unsettled region. As fast as these extensions were made, the taking up of the land followed, and a period of industrial development resulted, until to-day the agricultural plains of the West and Northwest are producing their share of the wealth of the land.

The rapid development of any territory depends largely upon its transportation facilities. The Government recognized this fact, and made liberal land grants to the railroads as an inducement for them to push their lines into and through the undeveloped territories. As soon as these lines were constructed, low passenger rates to prospective settlers were granted by all the companies in order that the territory might be settled quickly. These same railroads, however, in many cases, did not follow the same course with their freight rates as with passenger rates, and, in consequence, the farmer, in many instances, was unable to market his crops on account of the high transportation charges.

This question is of such interest to all classes of people that during the past few years especially there has been continuous agitation on the matter of rates looking toward readjustment. One can scarcely pick up a daily newspaper or a magazine of the present day without seeing some article in which the transportation companies of the land are attacked vigorously by the writers. The politician, ever quick to grasp some popular subject, has also taken advantage of the agitation by the public, and has endeavored to further his own political ambition thereby.

We have to-day among some of our most prominent people those who believe, or profess to believe at any rate, that the transportation interests of the country, from the standpoint of the public, are not safe in the hands of the corporations, but should be owned and controlled by the Government. I verily believe that

the transportation companies in general are, to a great extent, responsible for this condition. That certain communities have been "held up," as it were, in the matter of both freight and passenger rates, there can be no doubt.

Many of the railroads, either directly or through the individual interest of their officials, have been interested in industrial concerns of one kind or another located along these transportation lines, and these concerns have, in a great many instances, been favored both in rates and in service. Again, there are many cases where the influence of heads of departments, or officials under whose jurisdiction this matter came, has been purchased by the industrial concerns, and in consequence, any concern which did not buy this influence, or, in other words, which did not have the advantage of the favoritism of the transportation companies, could in nowise compete in that field.

Glaring examples of such discrimination in favor of certain companies has come to light in the recent investigations made by the Government. It has been shown beyond any question that the Standard Oil Company, the so-called "Beef Trust," of Chicago, the coal companies of the East, and many others have been granted special rates in the form of rebates; extra mileage has been allowed them for use of their equipment, passenger transportation has been furnished their officials in one form or another—all of these tending to reduce their transportation charges. It is not strange, therefore, that the public at large should be so agitated over this matter, that it is a popular outcry throughout the entire country that transportation rates are too high. Public opinion has been aroused to such an extent that the last Congress was compelled to pass new and, in some particulars, stringent laws governing transportation companies in order that all patrons of the railroads should be treated fairly and equitably. The scope and authority of the Inter-state Commerce Commission was also greatly enlarged.

We, as representing transportation companies, oftentimes forget to look at this question from all standpoints. We must not blind ourselves to the interests of the people in this great question, nor to their rights, as it is only by the will of the people that any of our concerns are allowed to exist.

The sentiment of the people against some transportation companies has made it easy for a competing company to enter the field and secure from authorities, where necessary, rights to build and operate a railroad. This statement is applicable both to the steam road and electric lines. Whether competition is of any direct benefit to the people is a serious question. If the existing company were to gradually reduce the rates whenever it is possible, it would, I believe, result in a better and more satisfactory arrangement for the people and the corporate interests as well.

Interurban roads have, I believe, a better standing to-day before the public than any other class of transportation companies, and it is our duty in every way possible to preserve and promote this favorable sentiment.

Any transportation company is entitled to a proper return for service performed. Just what that return should be is a very difficult matter to determine. Many things must be considered in arriving at any definite conclusion. The cost of construction, or operation, taxes, depreciation, income on investment, etc., all go to make up this cost. These charges may vary considerably on account of varying conditions. One property may be built on an expensive private right of way, with modern construction, good equipment, etc. In this case it is fair to presume that the fixed charges will be high and operating charges low, comparatively speaking. Another road may be built on highway franchise, cheap construction throughout, and, in consequence, the fixed charges are small, and, more than likely, operating charges are high. The item of depreciation is of considerable importance in arriving at a proper charge. It is not, therefore, altogether fair that any rate should be based on operating cost, unless, perhaps, it be an average cost. That one property can be operated more economically than another goes without saying—conditions differing largely.

However, the passenger is not responsible for the building of a good road nor a poor one; nor is he responsible for the building of a road in a territory which will not support it when a fair rate is charged. We sometimes try to make ourselves believe that a property should earn a certain amount of money regardless of the fact that the people, our patrons, are not there in sufficient numbers. If such a policy is pursued we make the few carry the burden.

The public at large has become restless and is demanding that rates, both for the transportation of passengers and freight, be readjusted. The steam roads in the Central West have "harkened unto the cry," and are at this time lowering their passenger rates and readjusting them to meet this demand, and to my mind are acting wisely.

In the territory with which I am familiar, few, of any, interurban roads charge more than 2 cents per mile. Many of these companies are operating under franchise rights granted them years ago, and in most cases are not subject to franchise rate regulations.

I am of the opinion that a road properly constructed in a territory sufficiently populated to warrant the building of a road, can be operated at a reasonable profit on a 2-cent mile basis, and at the same time sufficient service for the accommodation of the public be given. In the operation of an interurban road, the matter of rate charged is no more important in the success of the road or of the attitude of the public toward it than the service given by it. As the population increases these rates can and should be lowered accordingly. In other words, a large volume of business can be done proportionately cheaper than a small volume.

At this time some of us in the State of Ohio are a little disturbed over the establishing by the last Legislature of the Ohio Railway Commission, whose authority shall extend over all transportation companies doing business within the State. If the commission established carries out this law broadly and fairly, as no doubt it will, and the railway companies do their part properly and promptly, I believe it will result in much benefit to the general public and to the companies themselves.

A ticket, according to Webster, is a card or a piece of paper which calls for something. Its purpose in the railroad business is to show that the purchaser has paid for transportation from one point to another. Tickets are issued in many forms and may be divided into two general classes, one to be sold by an agent at a ticket office to a passenger, and another to be issued by a conductor, being his receipt for a cash fare collected on a train. In one case the passenger gives up the ticket purchased at the office to the conductor in payment of his fare, and receives nothing in return. In the other case, he pays his money to the conductor instead of to the agent, and receives a slip or cash fare in return for it.

I am, and always have been, a great believer in the sale of tickets by a ticket agent wherever it is possible. Money received from ticket sales through an agent is sure to reach the treasury of the company.

It is, I believe, the duty of any company to provide a suitable place where passengers may wait for trains, secure information, etc., and any such place requires some one to look after it. An agent representing the company has, or should have, plenty of time to sell these tickets and answer all the questions which a passenger may wish to ask. I also believe that it is advantageous to the company as well as to the passenger to sell a ticket to the passenger's destination, wherever that may be. Many companies sell their tickets at a less rate than is collected on the cars if cash is paid, in order to induce the public to buy tickets at ticket offices.

The conductor of the interurban road to-day has plenty of work to do in looking after the safety of his train, the embarking and disembarking of passengers, the ventilation of his car, etc. The safety of his train is, and always should be, the first thing to be considered, and it is proper, therefore, that the matter of collection of fares should be made as convenient and with as little work as possible. I do not think any one disputes the fact that tickets can be collected much more conveniently and in much less time than cash fares.

There are also among our conductors, as well as all classes of people, those who are inclined to be dishonest. In the collection of cash fares there is, I think, more opportunity for dishonesty than in the collection of tickets. Again, many people become dishonest through temptation, and if the handling of money can be lessened, the temptation to keep some of it is proportionately lessened. It is true, of course, that tickets can be manipulated by a conductor if he is so disposed, but hardly so easily as cash.

I have always felt that a ticket issued for transportation should be so made that one part would be collected by the conductor and another part retained by the passenger as a sort of identification slip or check. This, however, may not be practical, but, theoretically, to my mind, is correct. By using this form of ticket the passenger has something to show that he has paid his fare in case there should be any dispute about it.

While the business of an interurban road is not quite the same, in a way, as that of the steam roads of the country, yet I believe we make no mistake in following closely in their footsteps, they having had a great many years of experience in such matters.

SOME NOTES ON THE EVOLUTION OF ELECTRIC TRANSPORTATION

BY THEODORE STEBBINS,
Expert National Civic Federation, Cohasset, Mass.

The relation of transportation to civilization may be likened to the blood circulation within the body. Improved circulation nourishes the body; improved transportation advances civilization. The life of civilization depends on transportation. Therefore this association, organized to promote transportation facilities in certain fields, is a highly important agent of civilization.

Upon the organization of our parent association in 1886 its personnel consisted of companies operating cars in city streets with horses or mules as the motive power, and the meetings of the association were devoted mainly to a discussion of the feeding, shoeing, stabling and driving these animals. Before the close of that decade, a few venturesome companies tried electric motors, partly for expected economy, partly for humanitarian reasons. Those early electric equipments were crude. Some cars had a motor on the front platform, some had motors of only 7½ hp. New motor design followed new motor design again and again. It is not my intention to describe the events of this blood and money struggle by inventors, engineers, managers and capitalists for the next few years. Those early years are life memories.

Allow me to remark, outside the scope of this paper, that these frequent replacements of equipment, created in some instances so-called "water stock," that is, stock not represented eventually by physical property value, which stock has a legitimate birth and existence if we recognize the value to the city and whole country of this repeatedly and highly forced traction-service development.

What is the measure of our increased service to the public within these twenty years of progress?

A comparison of the conditions at present and ten or fifteen years ago reveals in a remarkable degree the benefits conferred upon the ordinary passenger by the introduction of the electric railway. For the payment of the same nickel he can travel, say, four times as far, and can ride, say, three times as fast on cars, say, twice as large and far more elegantly furnished. The cars run more often, say, three times as often, and are far better lighted and heated. Through the introduction of new lines, rolling stock has been increased during the twelve years beginning with 1890 from 32,000 to 60,000 cars, and now includes in the neighborhood of 80,000 cars. During the same fifteen years the passengers carried on the street railways of the country have increased from a little over 2,000,000,000 to considerably over 6,000,000,000. As a fair estimate of the increase of the population of the country during this time would be only 35 per cent the difference between 35 per cent and 200 per cent, combined with the better service already described, expresses the measure of the benefits to the public of these improved facilities.

Completely absorbed, as most of us are, in all-compelling daily routine duties, I mention these facts, that we may not forget how vital our traction service is to the community, to what splendid developments we can point in the last twenty years, and to add that equal possibilities lie with the future.

Last year this association was reorganized. Now we recognize and include "interurban railways." This enlargement of the scope of our activities is of great significance, an evidence of the virility of our organization; of its extending usefulness in the application of electric traction to wider transportation needs. The highest development of these interurban railways has been reached as yet only within a certain limited section of our country, and within such a recent time that many are not familiar with the scope of their usefulness and their demonstrated necessity in the economy of the community. This development has created within five years an extended network of service in Ohio, Indiana and adjoining States. The network in this section already connects 3600 miles of track, exclusive of city lines, and probably over 5000 miles inclusive of city lines. And even now the steam railroad world seems to have become inoculated thoroughly with "electric traction."

Looking at the chronology of electric traction, some assign the year 1886 as the birth of urban electric railways; 1896 as the birth of interurban railways, and 1906 as the birth of electrified steam railroads. Look next at the benefit to the community. As applied to city railways, electricity supplies a hitherto unused motive power, and magnifies the economic value of the service. As applied to interurban railways, electricity supplies a new and previously unconceived public service, affording high-speed hourly transportation at low fares for person and property between country and city and between cities. As applied to steam railroads, what will be the result? How will it affect their methods of operation, speed, frequency of transportation, rates of fare, volume of travel? What will be the relation between "interurban" and "railroad?"

This seems a time of special appropriateness to record some distinctions in construction and operation of electric traction in these various applications.

Therefore, I present in detail the following notes: For brevity I use the terms "City Railway," "Interurban" and "Railroad," meaning respectively typical city electric railway, interurban railway and steam railroad. In making various statements it must be understood, without qualifying each, that I speak of ordinary typical and high-class practice, and not the exceptional which special conditions may justify or demand. My subject matter is classified as right of way, track, station, power transmission, rolling stock, passenger traffic, freight traffic and the future.

RIGHT OF WAY

The railroad owns its right of way in perpetuity, ordinarily free of restrictions of construction, service or speed.

The city railway occupies public streets under a franchise, limited in term, and with obligations relating often to track, paving, sprinkling, speed, service and fares. Often a manager, making a life study of how best to serve every interest concerned, is much embarrassed by the ideas of inexperienced municipal communities. The limited-term franchise defeats its intended purpose. It repels capital seeking a permanent investment at low interest rate. It encourages speculative management at the expense of the physical property and its service. How much wiser to give the railway perpetual "location," as it is called in Massachusetts, subject to the regulation of an experienced State Board with a broad-minded and settled policy.

The interurban has in the country its private right of way, and in each city traversed either its own franchise or running rights over city track. Its operation, as a whole, is dependent upon franchises—often numerous ones. In some few cases the franchises have been procured only by agreeing with one city to specify rates of fare over a track running many miles without the city. Some lawyers hold that cities cannot prescribe conditions of operation without their municipal limits, and that county authorities can prescribe methods of construction affecting traffic on the highway, but not methods of operation, schedules or fares.

In some cases interurbans, while entering cities and traversing towns, could secure private right of way for some part of the distance, avoid street accidents, and, above all, shorten schedule time, and really diminish ultimate capital outlay, since track construction costs only half on private way what it does in a paved street, and can be maintained so much cheaper.

TRACK

In its construction the track of the best interurban roads is identical with that of the high-grade steam railroads, except, ordinarily, the interurban rail is 70 lbs. and the railroad rail is 100 lbs. to the yard. In both cases the prominent features are good drainage, abundant crushed stone or gravel and low grades. As to curves, interurban practice should differ from railroad practice. The single-track interurban, with its vastly more frequent train service at higher speed, and with less experienced employees, should provide special safeguards at curves not affording a free view across the curve of approaching cars, and if a free view is impossible, should double-track the curve, which is an absolute prevention of head-on collisions, or set slow signs. Often a trifling sum spent in removing trees and bushes will give substantial protection against collisions.

From experience already accumulated the average interurbans are progressing constantly toward the highest railroad practice in track construction (excepting in weight of rail), and the best interurbans have reached it already.

The city railway track in paved streets differs radically from either of the above, with a 100-lb. girder rail, different drainage, sharp curves and shallow special work. The heavy interurban car depreciates such track rapidly unless it is of a high standard of heavy construction. Interurban cars are often handicapped on city railway tracks by light construction, shallow special work, by the city railway cars, municipal restrictions on speed, and other features, and would be exceedingly fortunate could they reach the business center of the city by traversing less mileage of suburban street and securing a portion of private way. To illustrate, in one case, an interurban makes 75 miles in 3 hours, of which 1 hour is taken in only 10 miles of city street.

The above standards are the final evolution from horse-car service of 35-lb. rails, light joints and little or no ballast.

STATION

The pioneer power plants contained usually a few 80-hp dynamos, simple non-condensing engines, tubular boilers; in contrast, a modern plant may contain 8000-hp generating units, and condensing high-pressure steam plant. Direct current was then transmitted a few miles only at 500 volts; alternating current may now be transmitted very many miles at 40,000 volts. The salient features for a modern model plant are abundant land (for extensions), good soil or rock foundations, the greatest abundance of condensing water, the most convenient delivery and storage of fuel and economical machinery simply arranged.

As between city railway, interurban and railroad service the stations do not vary in type, but only in capacity and kind of current generated. For short transmission, 600 volts direct current is generated. For longer transmission in the larger city railways and all interurbans and all railroads, alternating current is gencrated at 10 to 40,000 volts.

POWER TRANSMISSION

The conductor on which the car makes its electrical contact is located over, under or alongside the car, and known respectively as trolley, conduit or third rail. The overhead trolley has had a remarkable career. Practically unchanged, except a little heavier, during twenty years of evolution it has witnessed repeated and radical change in every other part of the equipment. Electric traction was made possible, and has grown to immense proportions by virtue of the overhead trolley. It encircles the world.

But for heavy tractions by direct current and on private way, the third rail, with its conductor of iron and small erection cost, is cheapest and best, but it should be protected from sleet. The manager, studying every comfort for high-speed long-distance travel, should consider it pleasanter to passengers to avoid the overhead construction, with noisy overhead trolley and poles flickering by the view.

The conduit is unnecessary and objectionable for railroads and interurbans, and too expensive for the ordinary consideration of city railways.

The overhead trolley will continue a necessity for city railways on public streets, for most interurbans also, because they traverse so many public streets of the cities, towns and villages served, and, perhaps, also for railroads if high voltage must be delivered to the car.

From station to sub-station high voltage lines carry the current, and these when well constructed give practically no trouble except from lightning, falling tree limbs and malicious youths. The damage from lightning has been diminished by improved insulators, but the interruptions still occur. A high-tension line following the track, beside a public highway, passes old homesteads, and underneath fine old trees, which the owners cherish and will not part with. Malicious youths will aim at insulators with bullet and stone, but usually only at some favorite loitering spot.

ROLLING STOCK

While the construction of track, stations and current distributing systems are matters largely for the broadly experienced engineer to decide, the selection of rolling stock involves more conditions and has such a potent influence on the financial results of the whole enterprise, that it should command the combined wisdom of all concerned. So many elements are involved that it is difficult to observe an orderly selection in mentioning them. Some elements involved are headway necessary properly to encourage travel, speed always limited by safety, and in city railways by number of stops, and on railroads by power cost, volume of average travel, fixing car seating capacity and excursion travel, fixing number of extra cars, weight determined from seating capacity and speed, number of motors per car fixed by cleanliness of rail, usually one to each axle for city streets, or unusual acceleration, or one to four axles or less for locomotives, and loaded cars attached on clean rail with moderate grade acceleration, not to mention numerous other elements. The limits of ordinary practice lie between cars varying in over-all lengths from 20 to 70 ft., in seating capacity from fourteen to seventy, in weight, empty, from 8 to 55 tons, in maximum speed from 15 to 65 miles, and in motor power from 30 to 500 hp.

The increase of car speed induces travel, increases receipts, reduces every expense except accidents and power bill. Higher speed requires stronger cars for protection in accidents, but the heavy cars increase the power bills much faster than they reduce the car maintenance expenses. Some interurbans have 8 lbs. of dead car weight to 1 lb. of paying weight, and could operate lighter cars with better net economic results.

PASSENGER TRAVEL

Let us consider interurban passenger travel compared with that on city railways and steam railroads. It partakes of conditions in both and occupies an intermediate ground. There are the interurban 5-cent riders to and from terminal cities, and not always profitable. To stop a heavy high-speed interurban car costs too much in loss of time and power to leave a satisfactory profit out of a nickel. Some interurbans have adopted a minimum fare of 10 cents. There are the through passengers possibly paying 75 cents each. Three of them may be more profitable than a crowded car of 5-centers. Through travel deserves every encouragement. Such passengers are often secured in competition with the steam railroads, and every convenience and comfort must be afforded them. A trip of a number of hours duration on an interurban may be decidedly tiresome unless roadbed is smooth, trucks easy, seats comfortable and stops infrequent. The serving of local and through pasengers reaches a happy solution if the volume of travel will support an independent service for each. Some few interurbans operate cars with superior furnishings, chair-seats and the like, with stops only at the more important towns 10 or 20 miles apart, and may charge an extra fare in compensation either for the higher speed or the better car furnishings or the more exclusive accommodations. In estimating the profitableness of this special service, it should be realized that a number of the passengers would otherwise have taken the local cars.

On the city railway one pays a fixed price per trip, independent of the distance traveled, and the collection of fares is relatively simple. Some interurbans have appeared to fix fares on the city railway basis, not realizing that heavier cars, higher speeds, less frequent headway and fewer passengers more nearly approximate railroad conditions. Interurban fares are commonly calculated on a per mile basis. Tickets are sold in great variety. Using the word "local" to mean good only on the line of the selling road, and the word "interline" to mean good on one or more connecting lines. I specify: Local one-way card tickets, local round-trip card tickets, local mileage books, local commuter (or monthly) books, half-fare one way and round-trip tickets, school tickets, local excursion tickets, interline one-way and round-trip tickets, interline (or interchangeable) mileage. These tickets may run into enormous number and kind. On one system I found on sale 400 kinds of card tickets. The gradations of rates for these different classes of tickets depend on local conditions and ideas of the management. To illustrate one case, I fixed approximately on the following standards: One-way adult ticket 2 cents per mile, round-trip adult 1 8/10 cents, children, age 5 years to 12 years, one-half the preceding; mileage books 1 2/3 cents, commuter books (fifty rides, within thirty days, one individual) 1½ cents; school children 1 1/5 cents, and for excursion rates I will say 50 cents per car mile, measuring both ways, not in one direction. Excursion rates vary enormously per car mile, and the conditions that determine them are complex. Interurbans commonly maintain full fares on summer Sundays and holidays, and carry full loads, while some Western steam railroads run Sunday excursions at a third to a fifth of regular rates. On weekdays the interurban with a park is justified in making carload rates that may figure low, say ½ cent per passenger per mile. The city railway, with the enormous patronage which a 5-cent fare may attract, can afford to spend large sums on a park, against which the interurban, with a park 10 or 15 miles out of the city, cannot draw nightly any considerable casual patronage at a fare of 25 cents or more, unless the park has natural attractions. The interurban competes sharply with the railroad on conventions. Its chances are better on small conventions, say under 200, than on large conventions, say over 600. Its chances are better on a one-day convention under 50 miles than on a more prologed and more distant convention.

Speaking of general travel, many interurbans will secure more through passengers when they can give better connections and better handling of baggage. Through travel is especially profitable to interurbans, and should be cultivated in every way. The all impelling motive for the through passenger in the majority of cases is this: The interurban charges, say, ¾ cent less per mile than the steam line. On a 200-mile trip this amounts to $1.50. Say the steam line takes 5 hours and the interurban 8 hours. But the interurban runs hourly, can be reached more conveniently, and leaves one nearer destination. Now most people give up the day to such a trip, and the saving of a few hours means nothing. Retaining $1.50 in pocket is a tangible thing, meaning much.

Besides interurban travel is more pleasant than steam travel, especially in summer.

FREIGHT TRAFFIC

Let us also consider interurban freight traffic compared with that on steam railroads. The steam railroads live on their freight business, it affords double the revenue of passenger, they handle the business by wholesale, have enormously powerful and efficient locomotives, most extensive terminals and a most comprehensive organization within and between their companies. The interurbans may earn one-tenth its revenue from freight. The interurbans' freight business is bound to increase a number of fold. It suffers limitations, however, from inadequacy of terminal facilities, from the frequency of passenger service on a high-speed single-track interurban line, from the objections to ordinary freight cars traversing city streets, and from the rules of railroad freight associations against exchanging cars only between their own members. In some cases this rule is not observed, but generally it operates. Few interurbans do any material amount of carload lot business. Rates do not differ materially, and there is a large and growing business coming to the interurbans of a most miscellaneous character, of which much is secured through quickness of delivery.

Some interurbans do an express business only. The difference between "freight" and "express" is not quite clear. There is a clear distinction in the rate sheet, but not in the service performed. A full express service includes wagon call and delivery. In one case I compared an express business with wagon service and express rates on one interurban with a freight business, no wagon service and freight rates on another interurban. After deducting cost of wagon service, the earnings in each case were the same, *i. e.*, nearly 30 cents per car mile. To do a profitable freight or express business on an interurban requires a judicious discrimination in the class of business sought.

THE FUTURE

The superior convenience of electricity gives it no visible successor for city railway service. The convenience of electricity has operated powerfully to create the interurban business. Did steam railroads operate a passenger service only, I doubt not that electricity would quickly be adopted. For railroad freight service the enormous investment required for electric traction is the obstacle in the way. Other motive powers deserve watching. The gasoline motor is making enormous headway in automobile service, but several railroad cars which I have seen so equipped do not fill the bill. They require engineers rather than motormen. The gas turbine may solve the railroad problems, but this device has not got beyond the magazine columns.

In conclusion, it was my intention before commencing this paper to give a mass of statistical information, but without much explanation it is often misunderstood, so I have simply made this notation of facts, familiar to many in the interurban business, but which I hope may afford some food for contemplation to others.

SELECTION OF TRAINMEN

BY CLARENCE E. LEARNED,
Superintendent of Inspection, Boston Elevated Railway Company

A brief investigation of the methods and practices of different roads disclosed the fact that the subject assigned to the writer had already received so much serious and careful consideration in the past that it was difficult to suggest anything new. Many companies have adopted a general standard form of application, and similar, if not identical, methods of inquiry and investigation, and it seemed as though there was but slight opportunity for suggestion or improvement relative to either the questioning of applicants or the manner of examining into their character or previous employment.

The keynote to the successful selection of men for railroad work appears to rest largely in the company's ability to create an interest in the mind of the applicant. No one can explain why one man will naturally take interest in one thing, while another is interested in that which is directly opposite, but it is certainly a fact that without interest little or nothing can be expected or accomplished. If a man can be made to become interested he will invariably develop a good memory regarding every detail connected with the work. The keener the interest the more likely is the person entertaining it to be successful. Theoretically one can enter into lengthy explanations of what should be done to insure the successful selection of men, but what are the real conditions and facts surrounding the question, and what does the word "successful" mean to railroad managers?

All railroads are conducted to make money, and to railroad managers the meaning of the word "successful," as applied to trainmen can mean no more or less than those who can be depended upon to guard and protect the company treasury from loss by accident or theft from failure to register fares. In an endeavor to secure that which is so essential to the financial interests of those concerned, it would be well to consider what opportunities the department of employment has to obtain men who will accomplish this object.

Considering the responsibility of the position, it might be said that many of those applying, especially to companes in large cities, do not compare favorably with, and are below, rather than above, the average of those applying for positions of equal responsibility and trust in other lines of work of equal grade.

This should not surprise us, nor should it be construed as to mean any reflection upon the service. The demand for men is so great on the larger roads that these companies are confined for the most part to the selection of men from applications of those living directly within their city limits. The nature of the work itself is largely responsible for so great a percentage of the undesirable element applying, inasmuch as it gives the men more opportunity to loaf or be absent from work than any other position they could obtain.

The opportunity for the country-bred boy to enter railroad work is such that it is simply a question of circumstances, whether he starts in the town or village where he is born, or leaves home to begin his career in some large city. The chances are, however, that he will start at home, and the conditions relating to ability and character of those applying might in consequence be just the reverse of that described above in the case of roads in the smaller cities. While these are the men so much desired by managers of roads in large cities, the opportunity to secure them seems to grow less and less each year.

All railroad managers want good men, and while the young men who seek railroading for their life work might be considered ideal employees, those in charge of employment departments should not let slip any opportunity to secure the country-bred boy for the service, for he is the one most needed to bring up the standard of those applying for employment upon city roads.

The business of railroading is a specialty, and it is necessary for a man to possess certain special qualifications in order to become successful. To reach the highest pinnacle of advancement in the profession he must possess an ability equal or superior to that of those employed in almost any other trade or business.

The desire to learn a trade or become a merchant sometimes manifests itself in a boy at a very tender age, and is encouraged. In fact it is the aim and ambition of the parent to have the boy select that business for which he is best fitted, and every effort is made to secure a position in the best mercantile house of the particular business selected; or, if a trade is chosen, to apprentice him to the one believed to be the best, and throughout the boy's entire apprenticeship period the parent will, when possible, confer with his employer and advise and assist the boy to succeed.

Merchants and tradesmen receive applications for employment from those who possess, or are supposed to possess, some special qualification for the trade or business selected, and to merits of the applicant for the work selected are demonstrated at an early age. This advantage the merchant has over the railroad manager, for even though the desire to become a railroad man might manifest itself in the boy as early in life as the desire to learn a business or trade, little or no opportunity exists in railroad work for the apprenticeship of boys, and parents, therefore, are liable to discourage rather than encourage such selection.

The selection of men for railroad work, owing to the nature of the business, must be made from those who have reached their majority, and while this is a disadvantage to the young man who seeks work before reaching this age, there is a compensating advantage over the mercantile trade in the short time required for one to perfect himself sufficiently to earn a wage that exceeds that which he could earn at the age of twenty-one in many other lines of work.

For the purpose of bringing the subject before the convention in a manner that may lead to the suggestion of something new or original, it is well to deal with matters and conditions as they are, and it is hoped that the result will be accomplished in considering the "selection of trainmen" under the following heads:

(a) Selection of superintendent of employment and assistants.
(b) Office and waiting room of superintendent.
(c) Conditions governing selection.
(d) Inducing men to apply and analysis of those applying.

(e) Qualifications deemed necessary and examination of applicants.

(f) Selection of instructors and training and care of men selected.

SELECTION OF SUPERINTENDENT OF EMPLOYMENT AND ASSISTANTS

The superintendent of employment should be a good judge of human nature, and be able to quickly and accurately determine whether the applicant possesses the essential qualifications required for the service.

Time is a very important factor in railroad work, and while the superintendent should have the ability to quickly determine the possible fitness of the applicant, he should realize that the time given to the examination is profitably spent. He should possess such a personality as to inspire confidence and ease in the applicant, and thus secure more frank and accurate replies to questions asked.

The applicant should be impressed with the fact that the management is whole-souled and generous, and that if he secures employment he may be confident of receiving just and liberal treatment.

The assistants to the superintendent of employment should also be selected with as great care as the superintendent himself, and should possess, so far as possible, the same qualifications. They should by their manner, speech and judgment, in dealing with applicants, make clear in as simple a way as possible the duties of the position sought. One word hastily spoken might easily be so construed as to result in the discouragement of the applicant. Much depends upon these assistants, and as it is through them that the applicant must reach the superintendent, the detail of their work should be so arranged as to prevent, as far as possible, their showing partiality or favoritism.

A sufficient corps should be employed to make it unnecessary for applicants to wait an unreasonable length of time, as beyond the superficial examination the filling out of the application blanks is probably all that is necessary to do on the day of applying.

In the examination of an applicant regarding his reasons for applying and in asking pertinent questions pertaining to his previous employment, great care should be exercised not to offend, but the aim should be to leave the impression in the mind of the applicant that the position sought is of such importance as to require the most searching investigation and examination. Every effort should be made to dispel that feeling which might be uppermost in the mind of the man applying, that he is begging for a position. He should be led to feel that the company desires men such as he quite as much as men such as he desires the position, that appointments are not made through favoritism, but wholly upon merit, and that the matter is strictly a business proposition, and if his references prove satisfactory he will be employed; thereby causing him to feel as ready to offer himself for a position on the cars as he would offer to sell the company merchandise. Start a man right and little or no encouragement will be necessary to interest him in what follows:

OFFICE AND WAITING ROOM OF SUPERINTENDENT

In order to produce a favorable impression upon the applicant the office of the superintendent of employment should be attractive and well appointed, and the fittings and furniture should be in keeping with the general offices of the company.

Waiting rooms in connection with the office should be equally well appointed, and devoid of all "cattle-pen appearance." Settees should be so comfortable that the time spent by an applicant while waiting may not result in his becoming discouraged and discontented. Fit up waiting rooms in such a manner as to bring them, if possible, above the standard of the man desired rather than below. The importance of this room has probably never had the serious consideration that it deserves, and the fittings and atmosphere surrounding waiting rooms in general have undoubtedly been the cause of many good men hesitating to enter, and have, perhaps, resulted in their not applying for employment.

There might be pictures of car houses and cars for applicants to study. In order that they might see the advancement of car service men, there might be large pictures of conductors, motormen, starters, station masters and inspectors. Tables of rates of wages, as determined by length of service or position, might be shown, and prominent display might be made of any special rewards, life or accident insurance, and the retirement on pension if such exists.

CONDITIONS GOVERNING SELECTION

Many general employment agencies are successfully and profitably managed by men of far less experience and ability than those selected to manage a department of employment for railroad service, and while these agencies are as exacting regarding the requirement of references, and as thorough in their investigation of the character and previous employment of the applicant, their opportunity for success is tenfold that of a railroad superintendent of employment, as they are simply required and expected to furnish information regarding the applicants' previous experience or fitness for the position sought.

As a majority of the applicants for service upon the cars have had no experience whatever in railroad work, there is little opportunity for the one in charge of the employment department to obtain any knowledge of their fitness for the position sought, and success in appointing proper men depends largely upon those applying.

Conditions sometimes force the selection of men known to lack some of the qualifications desired, and the merits of the men selected differ widely, even though those who are responsible for their hire have in mind an unvarying standard of excellence.

Supply and demand are strong factors, and the quality of the men selected is greatly influenced by the number of men applying. If the demand is for a greater number than those who come within the requirements it necessitates the selection of some who fail to qualify in minor details of examination, and in consequence men of inferior ability sometimes find their way upon the cars.

When found necessary to hire men known to be lacking in some of the particular qualifications set, is a proper effort made to communicate these facts to the one selected to instruct them? In order to prevent such men from becoming unnecessarily discouraged and dissatisfied, and to make successful men of them, they should receive special training and care after appointment.

To aid in this it is suggested that a qualification card be adopted upon which should be plainly set forth the particular points in which the superintendent of employment considered the applicant deficient. It would be an advantage to both the company and the man to have these facts known to the superintendent of division to which the man was assigned, he to select such an instructor as would be best fitted for the particular attention desired.

INDUCING MEN TO APPLY AND ANALYSIS OF THOSE APPLYING

It has been repeatedly said that the best are none too good for railroad service, but can it be said that any regular defined system or method has been adopted by railroad managers to obtain the best help the wages paid by them will hire?

To be successful in inducing desirable men to apply they must have their attention called to the service in a manner that will impress them favorably, and the only way open to large street railways seems to be through the medium of the press, as personal solicitation is out of the question for corporations hiring such large numbers of men. It might be as desirable and beneficial to railroads in large cities to handle this matter just as concerns engaged in mercantile business do. Everything, however, would depend upon the skill with which it was done.

One way to reach and attract the most desirable men would be for managers to make up a list of the towns from which they had hired men for perhaps a year previous, and for the papers in these towns to publish a short and interesting article regarding the man that the company had engaged from among their readers. This would lead others acquainted with those who had gone into the car service to apply, encouraged as they would be by the fact that success was equally as possible for them as for those they read about. It would also dispel the thought that when away from home they would be among strangers and unknown.

Matter regarding the opportunity of advancement in the car service might be incorporated into the personal notices above referred to, and in this way bring out what the company desired in a manner more forcible and effective than an ordinary advertisement or a general article on railroad affairs.

The statistics of the Boston Elevated Railway Company for the year 1905 are of considerable interest, for they show how large a number of applicants have to be considered in order to obtain even a moderate number of suitable men.

Out of 8000 applying, only 5000 were permitted to sign applications.

Out of 5000 signing applications, only 2000 were accepted.

Out of 2000 accepted, only 1750 were assigned to duty.

Out of 1750 assigned, only 500 were in service at end of year.

Of the 3000 not permitted to sign applications, 1800 were rejected on account of defective eyesight, 400 on account of lack of education or limited knowledge of the country, and 800 on account of undesirable appearance and evidence of liquor.

The cause for the loss of 3000 men after signing applications was due to the following reasons: 1800 rejected on account of unsatisfactory references, 600 on account of being ex-employees with poor records and 600 failing to respond to notice of appointment.

The loss of 250 after acceptance of application was due to rejection on account of physical examination.

The reasons for 1250 not remaining in the service for more than a year was due to the following: 150 failed to qualify, 525 resigned, and 575 were discharged.

From the above results it might be said that the stringency of the examination before admitting men to the service resulted in only the best of those applying being appointed, but as only about 30 per cent of those receiving positions remained in service over a year it does appear that outside of the small number failing to qualify the importance of the examination was not fully appreciated by those accepted.

It is not the desire of the writer to suggest in any way the lowering of the standard set, but it does seem as though something should be done to induce better men to apply, and if the above figures are a fair comparison of the results of other roads it would certainly give rise to the thought that only a few of those applying realized the responsibility or the importance of the position, and judging from the personnel of many of those applying, coupled with the results obtained, it is evident that they were also of the impression that there was little or nothing to learn about railroad business, and that the most common or ordinary man could fill the position.

To overcome this impression and induce those believed best fitted for the service to apply appears to be a matter that might well be considered, and it does seem as though some plan could be devised by which it could be brought about.

The business of railroading is, to say the least, peculiar, inasmuch as it has opportunities at all times for the employment of men, and the knowledge of the fact that applications would be received at any time might cause one to try all other opportunities first and leave the application for railroad work to remain the last.

To bring about the consideration of a railroad position before that of any other, every effort should be made by railroad managers to reach the unemployed with information regarding the wages earned in railroad service. In this particular it might be said that the advisability of paying learners a nominal sum while breaking in would be well to consider, as men seriously thinking of applying for a railroad position calling for apprenticeship might hesitate to give up ten to fourteen days to learn the business, and in view of this it seems as if it would work to the advantage of the company as well as the man if he receives some compensation for his time.

QUALIFICATIONS DEEMED NECESSARY AND EXAMINATION OF APPLICANTS

The requirements of the service demand as efficient men as those of any trade or profession, and to be successful in selecting those best fitted to give satisfactory service it does seem that more than the simple mental, physical or moral qualifications of the applicant should be considered, and besides obtaining a thorough knowledge of their character and previous employment, information as regards the wages previously earned, manner of living, as well as those dependent upon them should be obtained, with a view of determining their ability to meet their expenses with the wage of the position offered, as only those who could earn sufficient to meet their expenses could be expected to remain in the service, be satisfied with the work or do justice to the position, and without doubt the best man for the place is the one who has earned a less amount than that paid, as he would at once think that he was doing well and be perfectly satisfied with the position; while the one who had commanded a higher wage would soon believe that his services were not appreciated, and be quick to cause dissention by criticising orders given, or by belittling the ability of his superiors.

While it might be said that railroad managers were of the same opinion as to the proper man for the service, it should be borne in mind that the peculiar qualifications so necessary for railroad work cannot be determined or discovered by examination. Disposition is a most necessary and important factor, and the desire for the position makes it difficult and at times impossible for the examiner to detect the actual temperament of the applicant.

The ideal trainman is the one with the right disposition. The man of unquestionable reputation and character might be unfitted for the work due to being unable to cope successfully with the conditions so common to the service, and only the one who has sufficient strength of mind to be able quickly to control himself at all times—use judgment—be loyal—obey the rules—appreciate his position and conscientiously consider the wishes of his superior, is in the mind of the writer his impression of the suitable man for the service.

It appears that these qualifications can only be demonstrated by actual test of applicants in service, and in view of this fact it can only be satisfactorily determined after a period of probation.

The requirements established for men for train and car service should be of sufficiently high standard, both mentally and physically, to exclude the employment of men who are not capable of performing the duties of the position. The best possible service must be maintained in order to hold the good will and respect of the public. The growing tendency to introduce the merit system, fixed systems of promotion, and mutual benefit associations and establishment of pension fund is evidence in itself that the work of the railroad man is appreciated by the higher officials.

All companies fully realize the importance of permanency of employment and the entrance of street railroad work as a life occupation, and have consistently been bettering the conditions and increasing the wages of their employees.

The system of examining men has been very complete, but an analysis of the results obtained should to a great extent enable one to judge of the success of the present system.

The examination of applicants should not be confined to written answers to questions or printed forms, but applicants should be brought in close contact with the examiner, and in conversation demonstrate, as far as may be, their fitness or otherwise for the position. The superficial physical examination should show whether an applicant has any deformities, his use of liquor or excessive use of tobacco; also whether the applicant appears bright and alert, or dull and slow in his mental processes. Although a more or less elaborate plan can be mapped out for examination, it cannot be followed at all times, as the ratio between the number of applicants and the number of places to be filled governs the extent to which discrimination may be judiciously carried. The superintendent of employment must necessarily select a sufficient number of men from those applying to keep the ranks filled, and as a result he does his best to secure those who can be trained to be good railroad men.

The examination of applicants should disclose a reason for applying, and whether the applicant intended to make the service his permanent or temporary occupation, as a knowledge of these facts might influence the severity of the physical examination.

An applicant applying on account of a desire to change from indoor to outdoor work might feel at the time of applying that he simply desired to make the change temporarily on account of his health, and a rigid physical examination would show that he was in poor physical condition. This condition, coupled with nervousness, would be likely to result in his being rejected, and the company in consequence might lose a man whose general ability was far above the average. If the cause of his state of health had been considered, together with the length of service desired, it might have resulted in his being employed, and with a probability that the work so beneficial that he would finally determine to make railroad service his life work.

The medical examination now in vogue may not be too severe for those desiring permanent service, but it seems wise to consider the intended length of service of applicant in determining the severity of the examination.

SELECTION OF INSTRUCTORS AND TRAINING AND CARE OF NEW MEN

Much depends upon the manner in which the rules of the management are first explained, and to secure good results care should be exercised in the selection of instructors. Instructors should be chosen from the most practical men in the service, otherwise learners who by their natural gifts or education are capable of succeeding might often fail, as result of indifferent instruction.

To produce a perfect and finished article, even from good material, it must be placed in the hands of competent workmen, or unsatisfactory results are sure to follow.

It may be assumed that everyone applying for a position in the railroad service, whether it be temporary or permanent employment, is desirous of becoming proficient and will exert every effort to succeed, but it is perfectly clear that with all the pains a learner may take, however carefully he may prepare himself, he is sure to make mistakes, and to prevent such mistakes from discouraging a beginner and cause him to become dissatisfied with the work, care should be taken by superintendents, as well as in-

structors, to explain that these mistakes are to be expected, and if not too frequent they should not be taken too seriously.

Are railroad men born or are they made? And, while it might be said that there were born railroaders as well as born artists, it is without a question a fact that they are fewer in number; but why should not the railroad profession have as many successfully made men as that of any other profession?

While an almost absolute uniformity prevails among the different roads as to the selection of men, can the same be said as to their manner of training? The ability to retain men may be partially due to the success in training, and lack of proper training may cause the loss of many men.

The superintendent of employment can form but a general opinion as to the ability of the person appointed, and it then devolves upon the instructor to demonstrate the applicant's fitness for the work.

The expense incurred by the superintendent of employment previous to the appointment of an applicant warrants the expenditure of a still further amount in order to have the applicant properly taught and instructed, especially when expended upon a man who has successfully passed every test and examination up to the point of his being assigned.

The selection of instructors and the manner and plan of instructing should be as thorough as the selecting of the applicant, and the use of forms and blanks as fully as necessary for instructors as for those entrusted with the appointment.

The importance of teaching new men has lately received special recognition by the Boston Elevated Railway, for within the past six months over 200 men have been selected for this special purpose, and their wages increased 10 cents per day, and with such astonishing results that possibly the subject warrants more detailed explanation.

Conductors and motormen specially qualified to instruct have been selected from each division of the road, and the importance of the work was deemed so great by the management that the president personally explained to the men just what was expected of them, and with such good results that since the inauguration of this system very few men have resigned while breaking in, and few have been rejected on account of their incompetency.

Much depends upon the ability of these instructors, and consequently great care should be exercised in selecting them. Those with ability and no patience should not be chosen, for instructors must possess sufficient patience to dwell at length and with care upon all points in which the new man appeared deficient. They should have tact to overcome any discouragement that may arise, and sufficient ability interestingly to describe and demonstrate the work so as to make the applicant feel at ease and in condition to perform his duties without difficulty and with as few disagreeable features as possible, leaving him at the close of the day's work with a feeling of gratitude to his instructor for the patience and interest taken in his behalf.

ELECTRIC RAILWAY EMPLOYEES AND THE YOUNG MEN'S CHRISTIAN ASSOCIATION

BY E. M. WILLIS,

Railroad Secretary, International Committee Young Men's Christian Association

The growth and development of the electric railway lines of the country during the past two or three years have been very rapid, and suburban and interurban trolleys are now reaching villages and hamlets, which, heretofore, have been practically isolated. Electrical equipment has been greatly improved; larger and more commodious cars have been built. In some places dining and sleeping cars are now in daily operation. Heavier rails have replaced the old ones; much faster time is being made and runs increased in length considerably.

These new conditions have given occasion for the consideration of the employees in their leisure hours by the officials of the companies. There has been as marked an advance in the standard of the employees as in the matter of equipment, and the men who are now running as motormen or conductors are of a higher type than formerly. An intelligent, practical man in the service can do much toward the saving of time and money when a car gets out of order on the road. Such men are being sought out by the companies.

Many of these young men come from the farm or village, and are generally free from the vices of the young man of the city. In order that they may remain sober and industrious, it is necessary to look after their welfare when off duty. At terminals or junction points these men have time on their hands, and are almost always ready and willing to put it to such use as will enable them to advance in position and salary. Unfortunately at the point of many of these "lay-overs" or "swings," there are no places where a decent and self-respecting young man cares to spend his leisure hours. The saloon and other places of questionable character are always the first to locate at the terminals, and these conditions make it necessary for some good wholesome agency to counteract their influence.

In the minds of many the railroad department of the Young Men's Christian Association is an organization that can do effective work among the men. For thirty years the association has been in operation on the steam railroads of North America. Over 80 per cent of the entire mileage of the country is now co-operating in this movement. There are 221 associations, with a membership of over 82,000 men, and 149 buildings, valued at $2,676,350, are owned or occupied by these railroad associations. The buildings are, in many cases, as well equipped with baths, wash rooms, alleys, pool and billiards, libraries, reading rooms, restaurants and dormitories as the average club house. In fact, they take the place of the home for the men who are on the road. Lectures, entertainments, concerts, etc., are given, and religious services held from time to time. It is a common occurrence that when a despatcher wants a man to go out on the road he telephones or sends to the railroad buildings. The men are generally to be found in some part of the building and are ready to report at once in good physical condition for the strenuous work required.

The men are charged $5 per year for membership, and a small fee for games and the sleeping privileges. Wherever possible, the undertaking is in charge of a committee of management, consisting of officials and employees, this committee having the direct oversight of the general secretary who is the executive officer. The companies usually contribute $100 per month, heat, light and water. This amount, with the memberships and contributions from interested friends, enables the work to be carried on in a successful way financially.

The general supervision of these 221 associations is, to a considerable degree, under the direction of the railroad committee of the international committee. This committee consists of the following men, all of whom are prominent in railroad or financial circles: John J. McCook, of Alexander & Green, formerly receiver of the Atchison, Topeka & Santa Fe, chairman; Charles F. Cox, of the Vanderbilt lines; Dr. John P. Munn, of the Gould lines; William A. Patton, of the Pennsylvania; B. D. Caldwell, of the Lackawanna; Abner Kingman, of Canada, with Morris K. Jesup, as chairman of the advisory committee. This committee directs the work of the ten secretaries who are assigned to various railroad systems of the country; two in Chicago, one in St. Louis, one in Richmond, Va., one in Montreal, and the rest with headquarters in New York City. The State and Provincial committees of the country are also co-operating in this work, and in a number of the States one secretary devotes his entire time to the railroad association of that particular State. For several years successful organizations for street railway men have been conducted at Rochester, N. Y., and Richmond, Va. All of these associations have enlarged their work, the one at Rochester having a downtown branch, and at Richmond, at Petersburg and Manchaster branches have been added; all crowded with men day and night. Associations have been opened recently at Memphis, Tenn.; Birmingham, Ala.; Sherman, Cal., and Atlanta, Ga. The following is the list of street railway associations:

	Members	Current Expenses
Alabama		
Birmingham	220	$3,000
California		
Sherman	150	.....
Georgia		
Atlanta (just organized)	.....	.....
New York		
Rochester (downtown)	.....	6,364
Tennessee		
Memphis	400	2,949
Virginia		
Richmond	684	4,272

Petersburg and Manchester branches included with Richmond.

A number of other cities are contemplating the organization of associations at an early date.

The Railroad Young Men's Christian Associations are organized on Christian principles, and this is a great element in their success. Fear has been expressed on occasions that this might hinder their greatest usefulness, but experience has shown that

there need be no anxiety in this direction, as every man who is disposed to be decent, whether he be Jew or Gentile, and a belief in religious things or otherwise, is welcome to membership. The railroad associations have also demonstrated that this plan, endorsed by the company, will bring about the co-operation of both employee and official, as both can meet on common ground in the association.

There is probably no greater opportunity for this work than among the street railway men, and in these days of consolidation and syndicates it should be comparatively easy to organize if the officials are ready. Local associations are generally formed, either at the request of the company, or on petition of the men. The company is generally asked to erect or fit up a building for the use of the men, and very frequently the men themselves will raise the money necessary for the furnishing. Whenever the local conditions are favorable a committee is organized to take charge. In many cases, however, this is not possible on account of the fact that the buildings are located at some distance from any local constituency.

Some of the helpful influences of the associations already in existence are seen at Rochester and New York, where 300 lunches are served each day, and where a pool room, opened directly apposite the car house, has been put out of business. At Richmond, Va., the club house of the association is crowded night and day. This building contains a small, well selected library, the gift of Miss Helen Miller Gould. At Memphis, Tenn., the work has been so signally successful that the local secretary, Mr. Black, was invited to a meeting of the Newman properties interest, and, as a result, the work at Birmingham, Ala., was started. This has been appreciated by the men. The rooms have been crowded, and the dormitories used extensively.

At Atlanta, Ga., a well equipped club house has been turned over to the Railroad Young Men's Christian Association, and an all-round association work will be conducted. At Sherman, Cal., an association was organized a few weeks ago, which now has 150 members. The small quarters set aside are already outgrown, and the president of the company has agreed to the erection of a building to be used for this specific purpose.

All the officials of the lines interested are most hearty in their commendation of the Railroad Young Men's Christian Association, and the presence of the men in great numbers frequenting the buildings is an indication of the way the employees appreciate the association. The thirty years' experience of the Young Men's Christian Association among the railroad men has demonstrated to all its adaptability to the needs of this class, and the very similar conditions among the street railway men make it possible for such a work to be carried on successfully for them. The international and State committees are ready to co-operate at any time in inaugurating these "homes away from home" for the men in the electric service.

UNIFORMS AND BADGES

BY JOHN R. McGIVNEY,
Purchasing Agent, New Orleans Railway & Light Company

The subject of uniforms and badges is a very interesting one. The uniforming of employees is one of the progressions of the street railway business made necessary by the change from the old horse cars to the modern electric palaces in operation to-day. No street railway company at the present time, whether large or small, would think of allowing employees to work on its cars unless fully uniformed, and there is nothing that will catch the eye of the patrons of a railway system quicker and cause more unfavorable comment than an untidily dressed employee. When you come across a company that has its motormen and conductors wearing a white collar and a clean, neat uniform of one pattern and color, you know these men are taking a pride and interest in their work, and you can also put it down that the manager of this railway is a live one, who has his men fully disciplined. There is a great deal that could be said on these lines, but more attention has to be paid to the inspection of uniforms by the manager in one section of the country than in another. In one section, where there is a long, cold winter, and the men have their overcoats buttoned up nearly all of the time, very little of the uniform proper shows. In another section—especially in the South, where the cars are vestibuled, both front and back—the men are exposed very little to the weather, and their uniforms show most of the time, and more attention has to be paid to them, and an important question arises as to the best course for the railway company to follow in order to obtain the best result in keeping its men neatly uniformed. Where the men select and purchase their own uniforms, and have to pay cash for them, they invariably purchase them at the place they get them the cheapest, overlooking altogether to examine the quality of the cloth, or, perhaps, they do not know the difference in cloth. If the uniforms are bought very cheaply, of course they are not going to get good ones, which means they will only get half the wear, and necessitates their buying double the number of uniforms they should buy in one year. When the superintendent gets after them to purchase new ones on account of their old ones being worn and not presenting a good appearance, you will find that some of them feel that they should not be expected to purchase more than two whole uniforms a year, and, in fact, have not made provision for more, and cannot pay for them, so that if the superintendent insists and wishes to keep these men, he has to arrange for the advancement of part of their salary to procure the new uniform, or the company has to stand good for them at the clothing house. Here is where there is no end of trouble, unless the men are confined to purchasing from one or two uniform houses, and even this is very unsatisfactory, as it is necessary to see that the employees pay the clothing house.

In my opinion, the railway company can obtain better results in keeping its men neat and tidy if it will help them by purchasing their uniforms and allowing them to pay the company for them in three or four payments. For instance, in New Orleans the men are privileged to buy their uniforms wherever they please, but they must conform to the uniform adopted by the company in regard to style and color, but each year the company solicits bids for both winter and summer uniforms for conductors and motormen. These bids are made according to the company's specifications, and are accompanied by sample uniforms and caps, and are required to be in the office by a certain specified date. The purchasing agent then removes the tags of the makers of the uniforms, and each uniform maker is given a lot number, from No. 1 up, and one of the best tailors in the city is then called in to closely inspect and select the best summer and winter uniforms as to cloth, workmanship, etc., conforming to the specifications. When the bid is awarded there is a notice posted at each car house notifying the men to whom the company has let the contract, and at what price. As previously stated, the men are not compelled to purchase their uniforms through the company, but they are, from practical experience, convinced that the company can get a lower price and a better piece of goods than they could. Care should be taken in awarding the contract to see that there is embodied in it the stipulation that the uniforms must be first-class in regard to workmanship. It is almost impossible to avoid at times a bad fit, or the furnishing of a uniform with bad sewing, in which latter case the uniform is torn or split in less than a week. In all such instances of improper fit or workmanship the contractor must mend, renew, or adjust the fit of the garment to the satisfaction of the purchaser without bothering the company.

When an employee needs a uniform he is given an order on the firm that has the contract, and, after he is fitted he signs a bill which, on his signature, the company pays. He is then allowed to pay for the uniform by having $2.50 deducted from his salary each pay day until the uniform is paid for. We find that more than 90 per cent of the employees avail themselves of this opportunity to purchase their uniforms through the company instead of buying them direct from the maker themselves and paying cash. Allowing the men to pay for their uniforms on such easy terms insures their nice appearance, as there is no trouble about getting them to purchase new ones when necessary.

To keep the uniform account accurate, a uniform ledger is kept by the company, and the charges are posted from the signed bill rendered each day by the contractor. The order for a uniform is only good on the day it is issued, and if, for some reason, the recipient cannot have it filled on that date it is necessary for him to come back to the office and get a new one on the date he desires to have it honored, as the contractor will not accept it on any other day but the one on which it is issued, so that there are no orders held out by the men, and the bookkeeper is always able to tell the paymaster or cashier what an employee owes in case he is leaving the service of the company and a settlement is to be made with him. There is a column on the payroll for the deduction for the uniforms, and as long as an employee's account is open the uniform bookkeeper puts down $2.50 along side of the amount due him, which is deducted by the paymaster and the amount credited to his uniform account. This is a very simple and satisfactory way to keep the uniform account straight.

The company requires the conductors and motormen, before they are finally assigned to a position, to deposit a cash bond of

$25, on which it pays them 4 per cent interest per annum. This guarantees the company against any loss on the uniform account; also in the collection of its money by the conductors.

The uniform buttons are made of brass with initials of the railway company only. These are furnished by the company and remain the property of the company. When an employee leaves the service he must turn over his badge and buttons before a final settlement is made with him.

The uniform cap for the winter for conductors and motormen is a blue cloth cap with spring top and black turned down visor, and is provided with rain cover. A black or brown straw cap with bell crown, with ventilator holes near the top and black turned down visor and rain cover is designed for the summer.

What has previously been said about the motormen and conductors looking neat and tidy applies more particularly to street aids (inspectors), transfermen, starters and car house foremen. They should be dressed in a neat uniform of the same color and style as that of the conductors, without the reinforcement of pockets of coat. A silk cap should be worn with this, and a badge to designate their office. A good street aid or car house foreman, in full uniform, which shows his authority with the company, commands the respect of the public in big crowds, delays to the line, and in all cases of trouble of any kind, and on such occasions he can accomplish more good for the company than any five men without uniform. Besides this, having a street aid uniformed and stationed around the city, watching and checking up the lines or riding over them, demonstrates to the employees and convinces the public that the railway company is having an eye to its business, and is giving it the attention it must have in order to operate with as little complaint as possible.

The railway company should use every means in its power to assist its men in keeping their uniforms clean. In winter, when the front part of the car is inclosed and the line operates through dusty streets the car creates a vacuum, and the dust is all drawn into the back end of the car, and unless the conductor keeps the back door closed the passengers are annoyed by it, but there is no escape for him, and when he reaches the end of the line he is covered with dust. This may, to a great extent, be remedied by a continuous sprinkling of the street and by providing each car with a whisk broom, in order that the men may brush their uniforms.

In regard to the badge question, the cap badge is the one universally worn, and it is a matter of choice with different companies as to what style to adopt and as to the material of which the badge should be made. The solid metal badge is too heavy, and bright metal tarnishes very quickly, and unless it is kept very clean and bright it is hard to distinguish the number, which is a very essential feature, as the badge number of both the conductor and motorman should be plainly displayed to the view at all times. One of the very best badges I have come across, for wear and also for lightness, is a celluloid badge with an aluminum back, with white lettering on a black background for conductors, and black lettering on a white background for motormen, the number in the middle, name of the company on top, and the words motorman or conductor at bottom, using even numbers for conductors and odd numbers for motormen. The number and leters on the badge can be plainly seen at all times, as there is nothing on it to tarnish, and there is no way to deface or damage it, except in an accident or with malicious intent.

For street aids, foremen, starters and transfermen, a black ribbon, with gold braid letters, with small piece of elastic sewed to the ends of ribbon and fitted over silk cap, makes a neat badge, which adds to the appearance of the uniform.

It would be difficult to select a general specification for an overcoat, relative to weight of material and style, which would be applicable to all sections, as conditions differ in the cold and warm sections of the country, and much depends upon whether or not vestibules are used on the cars. Of course, as to the color, it should correspond with that of the uniform.

I have tried to make this article as brief as possible, but think I have gathered into it all of the salient points; and to conclude, after going over a number of specifications of the different railway systems of the country, have selected the following, which, in my judgment, would make the best uniform for summer and winter service:

SPECIFICATIONS FOR WINTER UNIFORM

Uniform to be made of best blue, 22-oz. or 24-oz. (as preferable), Middlesex cloth, or its equal

Motorman's coat to be double-breasted; conductor's coat to be single-breasted, ⅝ double stitching, and lined with double warp Italian cloth or some lining equally as good. Coat pockets to be made of extra heavy duck and reinforcement around outside of all pockets.

Vest to be single-breasted, with six buttons and notched collar.

Trousers to have top front pockets, watch pocket and two hip pockets.

Buttonholes to be made with pure dye silk.

A set of detachable black buttons to be furnished with each coat and vest.

Cap to be of blue cloth, with spring top, black turned down visor and rain cover, or navy blue Scotch havelock, depending on locality.

Uniform to be first-class in every particular, and any defective workmanship or material to be repaired or replaced, as the case may be, without extra cost to purchaser.

Sample of uniform and cap to be furnished by each bidder, and those of the bidder securing the contract will be kept in the office of the superintendent during the continuance of the contract.

SPECIFICATIONS FOR SUMMER ACCOUNT

Uniform to be of the best thirteen-ounce Middlesex flannel, or its equal.

Coat to be single-breasted, ⅝ double stitching, skeleton-lined, with black Italian cloth, or lining equally as good. Pockets to be made of extra heavy duck, and reinforcement around outside of all pockets.

Vest to be single-breasted, with six buttons and notched collar.

Trousers to have top front pockets, watch pocket and two hip pockets.

Buttonholes to be made with pure dye silk.

A set of detachable black buttons to be furnished with each coat and vest.

Cap to be of black straw, with bell crown, and ventilator holes near top, with rain cover.

Uniform to be first-class in every particular, and any defective workmanship or material to be repaired or replaced, as the case may be, without extra cost to purchaser.

Sample of uniform and cap to be furnished by each bidder, and those of the bidder securing the contract will be kept in the office of the superintendent during the continuance of contract.

DISCIPLINE OF TRAINMEN

BY F. W. BROOKS,
Assistant General Manager Detroit United Railway

It is not from personal choice that I claim your attention at this time. I am here at the request of our secretary to say something on the topic, "Discipline of Trainmen." The very word "discipline" was to my mind more or less mandatory, as I read it in the secretary's letter, and accordingly I obeyed his request. I confess, in the beginning, that I know others here present who can treat the topic more comprehensively and intelligently than I can. That they were not called upon to do so is not my fault.

As I have learned in my experience in railway work, discipline among trainmen is not possible except where discipline is recognized as a cardinal principle, and is applied in every branch of the service and to every one from the highest to the lowest. Discipline is the surest guarantee of order and safety in the operation of a railway, insuring, as it does, the confidence and respect, not only of those engaged in the operation of railways, but also of the public whom we serve. Call to your mind to-day a prosperous railway property and you will find that, underlying its prosperity, discipline has been established and is being maintained.

Discipline should be an ever present potent factor. It should impress itself upon the youth who first enters the service. It should be of such a character as to command the mutual respect and confidence of the officers and employees for each other. It should be of a character that will withstand disaster. It should evidence itself to the public through the courteous and manly bearing, under all circumstances, of all of those in the service. When such a state of discipline is maintained the "discipline of trainmen" becomes a problem of comparatively easy solution.

I appreciate that on this subject managers entertain different views as to the best methods to be applied, but all strive to attain the same result. I am connected with a railway property comprising 617 miles of track, of which there are about 400 miles of interurban track. To conduct the service requires superintendents, despatchers, station agents, car-house foremen, and approximately 2000 trainmen.

With us, trainmen upon entering the service are at once subjected to discipline. An application must be filed, which must contain such information concerning the applicant as the company is entitled to possess; five references must be given, and if the applicant and his statement appear to be satisfactory to the officer whose duty it is to employ trainmen, he is assigned to a division, on probation, to begin his practice, the probationary period continuing for ninety days. During this period his previous and character is carefully investigated, and if found satisfactory he is then accepted as a regular employee, otherwise he is dropped from the service.

Upon entering the service each trainman is provided with the company's book of rules, by which rules he agrees to abide. These rules cover the standard regulations governing the service and require that the bulletin board be examined daily for additional instructions. If additional instructions have been issued, each trainman is required to acknowledge in writing within 24 hours after the bulletin has been issued that he has read and understands the instructions—otherwise he is not permitted to take out his "run." If the instructions are not understood by a trainman, he must apply to his superintendent for an explanation, and it is the duty of the superintendent to make such explanation carefully and fully.

We use the telephone for transmitting train orders. Trainmen are required to apply to the despatcher for orders and are prohibited from engaging in any unnecessary conversation. The use of the telephone line is limited to the transaction of the company's business, and abuses are regarded as violation of the company's rules.

Trainmen are prohibited from discussing the company's business with passengers or the public. The motorman is enclosed in a vestibule or cab and not permitted to talk with passengers at all. The conductor is required to give to passengers such information as they are entitled to have regarding rates of fare, routes, time of trains, connections and like information. Trainmen are required to be courteous to all patrons and the public, and it is our aim to rigidly enforce this rule. They are not permitted to go on duty except that they are in full uniform and must at all times present a neat appearance. The use of intoxicants, obscene language, or to engage in gambling at any time, is cause for dismissal.

Trainmen are provided with comfortable quarters at their respective headquarters and must report for duty 10 minutes before their runs are due to start. Our rules require that trainmen shall thoroughly understand the system of despatching—signals of all kinds, whether train, semaphore or signals displayed by the car or track and bridge departments. They are also required to know the locations of fire department houses, and to listen for and understand the signals given by fire apparatus when running to fires. They must also know the location of school buildings and churches, and in passing exercise special caution to avoid accidents.

I have mentioned these general regulations for the purpose of showing the conditions under which our men operate. Our discipline is designed to maintain respect for the rules and regulations, and our method of supervision is such as to bring to the notice of the management any violation on the part of trainmen of any rule or regulation.

When a violation is charged, the offender is required to report to our assistant general superintendent, who conducts an investigation to ascertain all the facts bearing on the charge, and who is authorized to take such action as in his judgment is warranted. If his finding is questioned by a trainman who is charged with the violation of a rule, then an appeal may be taken to the manager, from whose decision an appeal may be taken to a board of review, presided over by the president of the company.

This method is designed to afford protection to both the employees and the company. It relieves the subordinate officers of the duty of inflicting punishment, and insures the application of a uniform rule. Except when an immediate discharge is warranted, demerit marks are given instead of a suspension, and also merit marks are given in the case of specially meritorious acts. Under this system men are encouraged to improve in their work, and often by special effort are enabled to reduce their demerit marks, thereby insuring their continuance in the service. At the same time those dependent upon them have not been deprived of the earnings upon which they must rely.

In maintaining discipline, it is impressed upon those in authority that the relation between the company and its trainmen is of a private nature, and that in directing or reprimanding an employee, no unusual publicity must be indulged in. Reprimands must never be publicly given, nor shall there be any show of undue familiarity between officers and employees when on duty.

The company's badge is regarded as a badge of honor, and none may degrade it and continue to wear it. Respect for authority and for one another is enjoined upon each and every one in the company's service, and wherever you turn our discipline will be manifest.

In its maintenance there are always obstacles to be overcome, but persistency, determination and absolute fairness to all concerned will produce the desired result.

REPORT OF COMMITTEE ON INSURANCE

BY H. J. DAVIES, CHAIRMAN; T. C. PENINGTON AND R. B. STEARNS

At your meeting last year figures were presented to you tending to show that the premiums charged for the insurance of street railway properties against loss or damage by fire were excessive, that the losses by fire on such properties in ten years had been less than 30 per cent of the premiums paid, and that the traction companies of the country could better afford to carry their own risks than to insure their properties at the rates charged by the insurance companies. As a result of the publication of these figures, and of work done in Cleveland, with the approval of your committee on insurance, policies written within the year have been written at lower rates than ever before on the properties of those companies that have demanded a reduction. True, the insurance companies, through their inspection and rating bureaus, have in most cases required of the insured improvements that would somewhat lessen the hazard of fire; but a very slight betterment has been sufficient to induce a very material decrease in premium. There is danger now that the stock insurance companies will write policies at less than the probable losses and the cost of doing the business. This would be expensive and unwise, both for the insurers and for the insured, because it would mean, primarily, a loss to the insurers, and, ultimately, an increase in rates to the insured.

There has been practically no competition among the insurance companies for street railway business. The factory mutual companies compete with the stock insurance companies for insurance on "protected" properties, i. e., on properties equipped throughout with sprinkling devices that operate automatically upon the occurence of a fire, or buildings so constructed as to be practically fireproof. But these companies have been unwilling, until within about a year, to carry insurance, even on "protected" buildings of traction companies, their objection to writing insurance on such buildings being that, as most fires in car houses occur in the cars stored in them and originate below the roofs of the cars, such a fire would spread from car to car beneath the roofs and cause a heavy loss before the heat from the fire could reach the ceiling of the house and open the automatic sprinklers, and, further, that, as car houses are usually open at both ends, and, as in many carhouse fires, there has been a draft or suction of air through the buildings, heat from the fire, instead of opening the sprinklers immediately over the fire, would be carried to a distant part of the building and open sprinklers that would not play upon the fire, and that might exhaust the water supply before the sprinklers over the burning cars were opened, or so reduce the water pressure that the supply from the sprinklers in the immediate vicinity of the blaze would be insufficient to extinguish the fire. This objection was removed by a suggestion of Henry N. Staats, an insurance expert of long experience, who has been your committee's disinterested adviser, that, in addition to the ordinary ceiling sprinklers, a line of sprinklers be placed in each aisle of the new car house, so that, in case of a fire in a car, the heat therefrom would open sprinklers on the side lines and cause streams or sprays of water to be turned into the car through its transom and windows. Experiments to test the efficiency of such an equipment were made at Cleveland, Ohio, and at Newark, N. J., in the presence and under the direction of the leading insurance engineers of the country, both stock and mutual. The tests were made under the most severe conditions, and in each test the fire was confined by the sprinklers to a single car. After these tests the factory mutual companies said they would write car houses and their contents so protected, and the stock insurance companies made rates to meet the rates of the mutuals, which carry insurance at cost. To prevent a combination of rates between the factory mutual and the stock companies on what are called "protected properties," mutual insurance companies have been organized by street and interurban railway companies in Ohio, whose purpose is to insure only those preferred risks of traction and lighting companies that the factory mutual companies are willing to carry.

But fireproof and "protected" buildings are a small part of the properties of the street and interurban railway companies of the country, and the only companies now writing insurance on properties not fireproof and not equipped with sprinklers are the "old line" or stock insurance companies. There is no such competition for insurance upon these properties as there is for insurance upon "protected" properties. Therefore, in order that all

traction companies, those that have protected properties and those that have not, may have the benefit of reasonable rates for fire insurance, a number of street and interurban railway companies in the East and the Middle West are perfecting the organization of a stock insurance company with mutual features, to write insurance upon all classes of traction and lighting company properties. This company is to have a paid-in capital stock and surplus of $1,000,000 in cash. The rates will probably be the same as those charged by the "old line" companies, because this company and the traction mutual companies, before mentioned, will have their own inspectors, who, confining their attention to traction and lighting properties, will become experts in their line, and will make the insurance rates for their members. All the premium receipts of these companies in excess of fire losses, expenses and 6 per cent on the capital and surplus of the stock company, are to be returned to the insured. This means safe, sane and scientific insurance at actual cost.

The principle is not new. Some of the factory mutual insurance companies, organized by manufacturers to insure their own properties, have been in existence for seventy years. They have always carried insurance at low rates. They have selected their risk. They have insisted upon care upon the part of the insured in the construction and protection of properties. None of them has ever failed. None of them has ever made an assessment upon its members. Acting upon the same principle, the United States Steel Corporation, having large properties in many places, and not being subject to a total loss of its assets by any one fire, carries its own insurance. So does the Pennsylvania Railroad Company. So do other large railroad companies. The Philadelphia Rapid Transit Company is large enough to carry its own insurance. It has for years set aside sums for this purpose, until its insurance fund amounts to a million dollars or more. The interest on this accumulation is probably sufficient to keep it up to this amount. No single loss can exhaust this fund, for the company has not a million dollars' worth of property in any one location, unless it be at its power plants, which are substantially fireproof, or, at least, certainly not subject to a total loss by fire.

Not many traction companies are able to do what the Philadelphia company has done. Two or more of them may unite, however, to carry their own insurance. And this is exactly what some of us are trying to do, for the benefit of all of us. The plan of organization and work of these street railway insurance companies has been approved and endorsed by your insurance committee. They are to be owned, controlled, officered and operated by the street and interurban railway companies of the country. They are your companies, and are to be conducted by you for your own benefit. Many of you are familiar with them, for plans and specifications have been prepared by them for the protection of 444 separate properties of sixty-nine street and interurban railway companies.

The "old line" insurance companies have sustained very heavy losses within the past year or two, in San Francisco and elsewhere. In consequence of their unusual losses some of them may fail. A general increase in rates is inevitable. The work herein outlined has, however, prevented an increase in the average rate on street railway properties. A continuation of the work will keep rates down. Better still, a continuation of the work and your support of the new companies will bring them to actual cost. They ought not to be lower than cost. If the traction and lighting companies will unite to insure their own property, and will confine their insurance business to their own properties and conduct it with intelligence, with accurate knowledge as to losses and hazards, they can keep the cost of insurance where it ought to be. If they do not, and continue to place their insurance with companies that insure all kinds of property, and that base their rates on the hazard of particular localities rather than of particular classes of property, then they must continue to pay those companies rates high enough to cover, not only fire losses on their own properties, but losses upon more hazardous properties, commissions to agents, sub-agents and solicitors and profits to the insurers.

Are car houses and their contents so extraordinarily hazardous as to make it unsafe for street railway companies to organize for the purpose of carrying their own insurance? Are they, as has commonly been supposed, more hazardous than other properties? In the first place, while there have been some large losses on car houses and their contents in the past ten or twelve years, we know that those losses have not nearly equalled the amount charged for insurance. Secondly, they are not, as a rule, subject to what is called "conflagration hazard." A "conflagration hazard" is the hazard of risk of a property being entirely destroyed by reason of being in a compactly-built section that may be wiped out by a large fire. Car houses are usually in the outskirts of cities, far removed from the congested business districts. Thirdly, while the property of a street railway company may be worth millions of dollars, the property is not, like that of a manufacturing company, situated in a single locality, but is scattered in as many places as there are lines or routes of railway operated, and the largest loss that the company can sustain in any one fire is the value of the property that it has in one location. In writing insurance, each property is to be treated as a unit, just as it would be if each car house were owned by a separate company. This will make it safe for the street railway companies' insurance companies to carry large lines of insurance upon the property of each of their members

Your committee has considered the advisability of protecting car yards by the installation of open-head sprinklers between tracks, and by the erection of fire walls, but no actual fire test to determine the efficiency of this method of protection has been made.

The subject of the construction of car-storage houses and the protection of their contents has been considered and discussed by the National Fire Protection Association at its last two annual meetings, and we call attention, without quoting from it, to a very carefully prepared and able report made to that body this year by its committee on car houses, which was published in full in the STREET RAILWAY JOURNAL and "Street Railway Review." The 1905 report of that committee contained an interesting and detailed description, with photographs, of the car-burning experiments in Cleveland.

But greater than the duty of railway managers to their stockholders and bondholders to insure their properties against loss by fire is their duty, not alone to their stockholders and bondholders, but to the general public, to have no fire, and to keep the cars running. The loss of business consequent upon a car-house fire is likely to be larger than the value of the property burned. Against this loss there is no insurance. More important, then, than insurance against loss by fire is the protection of traction properties from fire. No plan of car-house construction that will prevent a fire, no practical method of protecting the rolling stock of street railway companies from destruction or damage by fire can be regarded as extravagant or improvident. More importance should be attached to providing protection aginst damage by fire than to providing a fund for replacing property destroyed by fire. Both should receive attention from your insurance committee, and from the insurance department of every street railway company.

Some two years ago Mr. Edward Atkinson, since deceased, who was probably the greatest expert on fire insurance in the United States, and a statistician of world-wide reputation, was consulted on the subject of the advisability of street railway companies forming insurance organizations for mutual protection against loss by fire. Following that conference, he wrote an opinion on the subject, from which we quote:

"Having been asked to express my judgment on the expediency of organizing a system of mutual insurance among electric traction companies covering power houses, car houses and other structures necessary to the work, I beg to say that the prime motive of the factory mutual system of insurance is to prevent loss by fire, coupled with a contract of indemnity for payment in money of the unavoidable losses which can neither be prevented by the owners or managers of the works nor by the experts employed by the underwriters in forestalling the causes of fire. Nearly every fire in factories, and correspondingly nearly every considerable loss by fire in the class of buildings connected with electric traction, is due either to faulty construction, bad occupancy or lack of requisite apparatus for extinguishing the fire in its earliest stage. It follows that if the managers of electric traction companies organize or join any mutual insurance company for the purpose of getting lower rates of premium without qualifying their works in every possible manner so as to make them fit to be insured at low rates, they ought not to be admitted to a mutual company that is under judicious management. If, on the other hand, they will make the officers of the mutual company their agents to point out to them existing causes of danger and remedies, and to devise safe and proper methods of construction and of conducting their work, they will gain the same very great benefit which has been gained by the members of the factory mutual system."

In the opinion of your committee, all the members of the American Street and Interurban Railway Association may be profitably consolidated into one company, to the extent, at least, of the insurance of their properties against destruction or damage by fire.

PROCEEDINGS OF THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION AT THE COLUMBUS CONVENTION

WEDNESDAY MORNING SESSION

The 1906 convention of the American Street and Interurban Railway Association was held at the Fair Grounds, Columbus, Ohio, Oct. 17-19, 1906. The president, Hon. W. Caryl Ely, of Buffalo, N. Y., called the convention to order on Wednesday morning, at 10:45 o'clock, and introduced the Hon. Lewis C. Laylin, Secretary of State, who extended the delegates a welcome to the State of Ohio.

Mr. Ely then called upon Robert Sheldon, president of the Columbus Railway & Light Company, who made a short but interesting address.

Hon. Dewitt C. Badger, Mayor of the city, then addressed the delegates on the part of the city. The Mayor was followed by John Y. Bassell, the secretary of the Columbus Board of Trade.

The secretary then proceeded to read the minutes of the various meetings of the executive committee during the year outlining the arrangements which had been made for the management of the affairs of the association and the plans for the Columbus convention. On motion the report of the executive committee was accepted and filed.

Secretary Swenson then presented the report of the secretary, which showed the membership to be as follows:

Oct. 1, 1906:	
Associate members	113
Active members, old	145
Active members, new	55
	200
Joined since Oct. 1	23
Old companies paid dues since Oct. 1	5
	228

The report of the treasurer showed the following financial transactions during the year:

Cash on hand and balance from last year and receipts during 1905-1906	$25,444.11
Expenses	18,467.21
Balance	$6,976.90

On motion the reports of the secretary-treasurer were approved and filed.

The secretary read a certificate of the auditing of the accounts of the treasurer.

President Ely then delivered the following address:

Gentlemen of the Convention and Members of the Allied Organization: I am standing here before you to address you in the capacity of president for the last time. Three years ago at Saratoga you all remember the condition into which the affairs of the association had drifted by some chance, and it transpired that I was flung into the breach. There were many men who had given careful thought to the affairs of the association, and its condition at that time was apparent to all. We were, in fact, a social organization, with some business, which we transacted in a certain desultory fashion. The organization had done a lot of good work, but its work was failing, because of certain conditions inherent to a situation that had grown up. It was, in the first place, an organization dedicated to a business that was small and that was based on conditions that had been outgrown, when a few individuals were largely the owners of the street railways. But there had come into the business a tremendous accretion caused by the electrification of street railways in the cities and the construction of great lines of arteries of interurban traffic, so that where a few millions had been represented in the business, billions of dollars had actually come to be represented, and, instead of men for the most part of a moderate degree of ability, there had come into the profession thousands of men of the finest ability possible for money to obtain.

The association was in such a condition that it was of no particular benefit to anyone. All who had been members of it loved it; many men connected with the business from the old days were devotedly attached to it; it had been the medium of communication between them that had brought about close ties, socially, as well as in a business way. I do not speak of the old organization in terms of contempt, and, as this is the last time I am to talk to you, I know you will not misunderstand me, because I have a message to you, and I believe I have earned the right to talk to you freely and pointedly. (Applause.)

The difficulties that attended the situation were very great. It is impossible to describe them; they are known to you. When we look back to a period three years ago we find that we were an organization without a home. No one seemed to be able to bear the expense of taking care of the entertainment of such a great organization. The meetings had been held in New York and in Detroit, and the street railways of these cities had acted as entertainers in the old-fashioned way, but the expense had become such a great burden that the people were not willing to assume it. We went for a couple of years like the wind, which bloweth where it listeth. We went where we pleased, and we commenced the work of reorganization. I am sorry to say that some men thought that it was impracticable to carry out the plans we laid, but it is given to some to possess the powers of imagination that others are devoid of, but without which the world would be to-day where it stood centuries ago. The men who embarked upon unknown seas, the men who have blazed trails through the wilderness of the forests and the business woods, have always been subjected to the criticism of those who knew not where the way tended, and whose powers of imagination and divination had not enabled them to see unless everything is plain and open. "Knock and it shall be opened unto you," and those who have knocked upon the closed doors and have put there in all the course of history, in the world's progress, are the ones to whom it has been opened, and men owe their thanks to-day to the men who have pounded, perhaps not in vain, but accompanied by others, have pounded until that which blocked the way has yielded, and then the way has become plain.

Now, for one, I wish to say as a serious-minded man who sometimes wreathes his remarks in smiles, I say as a serious and reflective man, that I saw a great responsibility resting upon the men who assumed, and upon whom it was put, to lead in the reformation of the organizations; I saw lots of difficulties, misunderstanding, responsibilities of different kinds to be assumed, but you had put me there, and when I assume responsibilities in all my life I have never been recreant knowingly to a trust that was imposed upon me. (Applause.) I have looked upon this business as if I were to receive a large salary in money for the transaction of it, and I thank all of you who have worked with me in this matter. It is to the credit of the business that there has been such unanimity of favorable expression and of helpful work and of common effort. Finally, last year, it was settled what the line of work should be and what we should do, and it was settled that there should be a central office whereat there should be maintained a secretary who should have a salary, and who should be selected by the executive committee with an idea to peculiar adaptability for the performance of the work that would be before us. Then the executive committee started out to lay down the line of work and to inaugurate it in every way. It was attended with a great deal of difficulty, but it finally came to pass that quarters were secured at 60 Wall Street and the services of Prof. Swenson were secured as secretary of the organization, and the work actually commenced.

Now, is it worth $600 for the largest companies in the United States to belong to this association, and is it worth to the other companies as you come along down the scale, graduating them by their gross earnings the various sums that they respectively pay, toward this organization? I think that is a fair question, and every man is entitled to be "from Missouri," and to be shown. It is impossible for the executive committee or the officers of the association to show to anyone a chain of $600 in nickels actually going into the treasury of the company—that is an impossibility—or the amount of money that anyone pays in. But to the work of the past year I invite your careful attention. It is impossible for me to more than outline it to you, but in the printed bulletins which have been sent to you from time to time, in the reports, circulars and letters of the various committees, and their data sheets, and in the program of this convention and the work of the Manufacturers' Association, in this the largest attendance that I have ever seen at the opening session of our convention, and in the committee rooms, wherein our affiliated organizations since Monday morning have been carefully and systematically carrying on lines of work that are parallel, though well defined—in all these evidences it seems to me is proof of the value of the work accomplished through the money that has been expended in bringing about the reorganization. A great corporation that takes in ten, fifteen or twenty million dollars can afford to hire the best technical men and bring to its aid the best ability in every line of this work of ours; that is to say, those companies are justified in an attempt to get the best. But when you think you hire the best it takes time to prove whether you have or not; and, suppose it were possible to conceive of an organization wherein all the men were the best, or almost the best in their respective lines of work, then you would have the very best organization that it would be possible for a single corporation to bring to its assistance. But then it would be limited to a very few men compared to all the thousands that throughout this land and throughout this continent—because our representatives come from all over it—that are carrying on the different branches of business. In the technical branch of the business a corporation is best able to fortify itself by paying handsome salaries and getting good men, but there are other things in which the large corporations are more vulnerable than the small corporations. The corporations of the great cities are reached far more quickly by the accidents of time and the changes in conditions than are companies in the smaller cities and interurban districts, and when you come to the final analysis, the security of the rights under which these corporations transact their businesses finally rests upon an honest and fair sentiment actuating the minds of the whole people. No line of work can be carried

on to greater advantage by this great organization than in proper ways, well revised and well calculated, to educate the people of the country to a just and thoughtful conception of the rights of corporations, and of the business conditions under which they operate. I fancy that there is not a man to-day who is well read and well informed in this business who doubts for a moment the right of the people of any community to take over in a fair way and operate the public utilities, any of them, through their municipalities or other territorial domain. As a matter of right, it is undoubted. Then it is up to you to say to the people that as a business proposition it is unwise for the municipalities to attempt to do a business which you are able to establish to the satisfaction of everybody can be done more cheaply for the people by private business interests than by municipal corporations. (Applause.) For years we were afraid to discuss the question. For years we said: "Don't bring it out and talk about it in the convention," and during all those years all the other fellows were talking about it, all the newspapers were spreading what was largely misinformation before the people, and a sentiment was forming against us, that, had the people who entertained it had the just and fair means of information, might have been very different from the manifestations that have become apparent within the last few years all over the country.

When we made up the committees we went about and asked suggestions from the best men in the business, men who were thoughtful and farseeing, and our attempt was to get able men, strong men, to do actual work upon actual working committees of the organization, and I cite you, gentlemen, with pleasure and with feelings of great pride to the lists of the committees of this organization and its affiliated organizations. And I say to you that in my best judgment, as a practicing lawyer for twenty years, one who has had experience for nearly fifteen years as a builder and operator of railways, and who has studied these questions in the sociological and every other point of view, that within the next five years it will be cheerfully acceded by the managers of the greatest corporations of this country that the work of the committees on municipal ownership and public relations of this organization, if they are conducted in the way that I believe they will be, will have been worth all this organization has cost to all the street railway interests. (Applause.) When it is possible for this organization to bring to the chairmanship of the municipal ownership committee such a man as C. D. Wyman, of Boston, a man with legal training, who knows how to collect evidence and the value of evidence and what it means when presented, and how to glean the facts from it about the law and to disseminate it—when you get such a man as that, who adds to all his legal learning and ability a personal knowledge of all the conditions that affect us, who represents companies and organizations in almost all the States of the country, thereby putting him in touch with the feeling that obtains throughout the country in these matters—when it is possible to bring the ability and the time of such a man as that to your service, who shall say what it will be possible to do? Who shall say what this organization will represent? I do not single out one man at the risk of having others feel that they, who are equally worthy and meritorious, are neglected, but I know I may rely upon every man who is working upon these various committees to know that his work is appreciated by you all, and I have not time to refer to all. I simply ask you to examine carefully, reflectively and thoughtfully the lists of committees, and remember that they are actively at work, and then I ask you to say to yourselves, managers and executive officers of great corporations: "Is it possible for me to obtain anywhere for $600, the paltry sum of $600, the benefits that move to me from the service on behalf of my corporation of that magnificent body of men?"

I want to say it has been very difficult to get the work inaugurated. All the gentlemen whose names appear upon the committee lists were communicated with, the nature of the work was made apparent to them, and they were asked by us if they would serve upon those committees. Many of them debated very carefully whether they were in a position to give the time that the work demanded. So that the committees represent a work of careful selection, putting to the members the proposition whether they could do the work, and their acceptance means that they are harnessed in this work by their own consent. So far, everybody is pulling well on the evener, and there is no kicking in the traces perceptible.

As has been known for years and so often said, the proof of the pudding is in the eating. A year ago we had a certain number of member companies, and this idea of reorganization was comparatively new, and I wondered, and so did many of the officers, how many we should have left at the end of the year. It gives me great pleasure to say to you, in summarizing briefly the report of the secretary and treasurer, that whereas last year we actually had paid up at the time of the convention and in good standing less than 187 members, we have this year 228 member companies and 140 associate members. (Applause.)

It is very important that we bear in mind what I believe to be the present situation. In talking to the engineers, I said that while much had been accomplished, success, in my judgment, was not yet assured. Mr. James H. McGraw was present at that meeting, and he said to me this morning, "I do not think that you were right in saying that success was not assured." I have been in politics since I was eighteen years old. When I was eighteen years old I commenced to make stump speeches. I want to say to you that nothing has ever burnt my fingers so badly in politics as a sure thing. (Laughter.) I have never been hurt in business so badly as by sure things. (Laughter.) They are deadly. They dull the brain. They paralyze energy; they stop effort. I say success is not assured. We have made some few first steps, and those who come after the present officers have a world of responsibility upon them to see not only that the present rate of progress is kept up, but that it is constantly accelerated, and that acceleration, like the power of the motors of the big cars that we have to move quickly, must be very rapid, because if we do not produce results, concrete results, within the next year or two of far greater magnitude, than we in our feeble way have been able to produce, there will still be doubts. But if you move the thing forward in the way in which it can be moved, and the way in which I believe the successors of these officers will move it, within two years you will wonder just as much at the conditions that have prevailed, and why they were permitted to prevail so long, as those who live fifty years after us will wonder how it were possible to have horses in the streets when horseless vehicles could be obtained.

I wish to speak of the work of the secretary's office. When a business man, especially a street railroad man, thinks of a college professor keeping books and doing actual practical work, he is quite inclined to doubt whether the professorial ability is just equal to coping with problems like ours. I wish to say, without any desire to flatter Prof. Swenson, because I absolutely do not mean to deal out any flattery here this morning, that he has brought to the management of the secretary's office a peculiar mixture of necessary qualities for that work. I invite you all to go to his office; he will be delighted to see you—I wish to impress upon you that it is your duty when in New York to go to the headquarters of the association to just look at things. You are paying money there, why not take a look in to see what the secretary is doing, converse with him, encourage him by your presence, and perhaps greatly aid him in some way that you may not know of? The work of the secretary's office has been very great. Out of those three small rooms have been turned, in the way of actual literature, typewritten, dictated letters, over 6000; received, over 4000; printed and memographed circulars and communications, over 20,000; printed data sheets, over 18,000, and bulletins, over 17,000. The books and records have been kept in the most perfect manner, as is certified to by Mr. Young, and for the first time, almost, you have an absolute roundup showing our exact situation with regard to the companies of this country. Now, that of itself is a great accomplishment, because there is a lot of work to be done to bring in all of the companies that should be in, that is word-of-mouth work, it is hand-clasp work, it is work of personal inquiry and of personal request. There are companies to whom you may send circulars from now until the crack of doom and they will never come in, but they will come in if they just get the word from the proper individual in the association and the right kind of a talk to inform them as to what is going on. The secretary is worthy of your co-operation, your visitation and assistance. The secretary's office ought to have a little more room and a little more help, and I trust that the incoming executive committee will take that matter up and very carefully investigate it. It is worthy of it. I have never seen, except in political headquarters where forces have to be quickly gotten together and a tremendous amount of stuff turned out in a very short time just before election, so much of that literature and work turned out of a small place like that as out of the office of the secretary of this organization. (Applause.)

I wish to say that the affiliated associations have risen to the occasion and the emergency in the most splendid way. Some of the organizations at first did not understand just what the situation was and how the thing was to be worked out. It was felt by some that somebody's heavy hand might be laid upon them and that they might be made to do things that they did not want to do, that the forms of organization were to be interfered with, and all that sort of thing. That has all vanished, like the dew before the sun. When we got together and talked it over that was all threshed out. They all came together. It was resolved that the constitutions and by-laws of the different organizations should be, in so far as was possible, just like the parent organization, and you will find in one pamphlet which has been sent to your office the different constitutions and by-laws, and they are in such shape that you do not have to read a lot of different matter in each one, but in some few details only do they differ, and those wherein it was necessary.

Now, these associations and organizations took right hold, rose to the occasion, as I said, and have been very, very helpful in every way, and have done their business in a way that has been very, very fine.

It seems to me that I have just about finished my message to you. I wish to say that I feel perfectly satisfied, and hope you all do, that this convention pitched its tent in Columbus, and while I shall take occasion hereafter to refer with more particularity to the different courtesies that have been extended to us, and the committee on resolutions will take proper action in regard to these matters, I wish to convey to the men and women in Columbus, who have turned out so beautifully to meet and entertain us, that we appreciate it from our hearts, and that we shall go away from here with the most beautiful recollection of your hospitality, of your handsome city, and the people that grace it with their citizenship. (Applause.)

John I. Beggs said that all of the president's remarks had impressed itself upon his associates, the other officers and the executive committees of the co-ordinate associations with such manner and with such force, that they all felt at this time, when the results of the inexorable flight of time brings them to a point where Mr. Ely should retire from the principal executive office of this great association and its co-ordinate associations, that they might place on record in the archives of this association, and express to Mr. Ely in a manner that would be enduring, some slight acknowledgement of their appreciation of the value which they place upon his untiring, patient ability on behalf of this association. There are many among those present who are charged with great responsibilities of administering these affairs who are

not here for the temporary honors, notwithstanding they highly appreciate them, but they are here to try to perform a great service to this great industry which is growing greater every day. Therefore, on behalf of the officers and executive committees of the five associations which are affiliated in this work, Mr. Beggs said, in addressing Mr. Ely, that he was charged with the pleasure and with the duty of presenting to him something that is emblematical of the triumph which all present believe had been achieved for the time being. (A bronze statue on a marble pedestal was brought in and placed on the platform amid great applause.) Mr. Beggs said that the statue typified "Triumph," and he desired, on behalf of this association, to say that he believed that Mr. Ely will carry with him, as those present will carry with themselves, memories as enduring as the bronze from which the figure typified "Triumph" has been modeled and molded. (Great applause.) Upon the base of that figure has been placed a tablet setting forth that the gift is a testimonial from the American Street and Interurban Railway Association, and from each one of the affiliated associations, that for all time shall show what was the inspiration which produced this combination of these associations. (Applause.)

President Ely, in a speech, acknowledged his appreciation of the gift.

ADDRESSES OF THE PRESIDENTS OF THE AFFILIATED ASSOCIATIONS

Mr. Ely then introduced the president of the Accountants' Association, W. B. Brockway.

Mr. Brockway said that he did not see how he could possibly condense into anything short of one hour and a half what he wished to say regarding the Accountants' Association and its work. However, he did wish to say that the Accountants' Association has worked in the past few years, he thought, in cordial and thorough harmony with the reorganization plan. It was this year celebrating its tenth anniversary. During this ten years much had been accomplished for the benefit of the street railway business in respect to accounting matters. Some of the members had worked all these ten years, and some of them had worked pretty hard, but he believed that all of the men would gladly repeat the efforts of these ten years, simply to be able to call, as they did, the Hon. W. Caryl Ely their friend. During the last year or two Mr. Ely had undertaken, willingly, the greatest hardship that a business man could undertake, getting off trains at half-past two in the morning on the business of the association, and Mr. Brockway said that he had yet to hear a word of complaint from him. At this present time Mr. Ely should be in a far distant place attending to other business than this, and it is undoubtedly true martyrdom for him to give up three years of his efforts in order that there might be built up an association which would typify this statue of "Triumph." (Applause.)

President Adams, of the Engineering Association, was then introduced.

Mr. Adams said that the Engineering Association sent to all a greeting and best wishes for a most successful convention. It had just passed through two days of successful meetings. Its papers had been presented in a very able manner and the discussion had been complete in every respect. It was to hold another session that afternoon. For the future it had laid out work for the standing committees so as to carry on the work continuously. His idea was that it is necessary to have the work laid out in that manner to accomplish anything of value. The support which the association had received this year from the treasury of the parent association had taken care of the requirements for the last year. Having in mind, however, the work of these standing committees he anticipated that the needs of the association for the future were going to be somewhat greater. The association also wished to urge upon the various companies, and no doubt this request would be echoed by the other associations, that when requests for information are sent out to the various roads that the data sheets, or whatever form they go out in, be put in the hands of the proper party or heads of department, and that the officials of the roads see that the heads of these departments give the necessary answer that should be given. It is only by such cooperation that the work could be accomplished.

Mr. Ely then introduced President Rhoades, of the Claim Agents' Association.

Mr. Rhoades said that he had prepared a report to give in detail some of the proceedings of this year's convention, but owing to the lateness of the hour he would pass over everything but two thoughts. One was the managers of the various street railway companies, who are members of this association, during the past twelve months had paid $10,000,000 to people who have been injured; $4,000,000 were paid because the motorman were permitted to run one car into another; $750,000 were paid because the fuses blew out. Two million five hundred thousand dollars, approximately, were paid because the motors dropped, or the straps broke, or there was grease on the floor or something of that sort. The other thought was a caution to be careful what cases were appealed to the Appellate Court. The cost of any particular judgment amounts to nothing compared with the principle involved.

President Ely then spoke of the Manufacturers' Association. He said that the president of that association is well known to every man in the street railway business throughout the world. There is probably no man who has gone to him and asked for information and assistance but has received something that was helpful to him. He is a man whose knowledge of the business is world-wide and who is devoted to the interests of the street railway business, that is James H. McGraw. Unfortunately, in laboring about this exhibit last week in the storm, Mr. McGraw contracted a very bad cold and could not be here at this time, but so well was that organization officered that a man was there to represent him, who is almost equally well known, namely, Charles C. Pierce, of Boston.

Mr. Pierce said that those present little knew the detail of the work which the Manufacturers' Association have attempted to do in Columbus, but which it is doing willingly and is going to try next year to do better. This was the third meeting in which the association had participated and the second appliance exhibition it had handled. The work was here, and it could be judged by itself. It had been honestly done; the funds were audited and honestly kept. During the first year at St. Louis the executive committee was obliged to make up a slight deficiency, but Mr. Brady, who was president at that time—the initial work of that man cannot be appreciated—said, "Never mind, we must take care of this thing and it must go on." Last year at Philadelphia the association was a little behind and the committee assessed the manufacturers. This year it would retire with a solid bank account to take care of the convention next year. Mr. Pierce said that he looked forward to the time when the steam railroad interests will come to these meetings as fully as the street railroad interests. He told that to the members of the Master Car Builders and Master Mechanics' Association some years ago, and they were commencing to believe it. A fraternizing of the two interests was going to be the end of this thing and it would be the grandest organization that the industrial world has ever seen.

President Ely, in closing the meeting, gave a high endorsement to the work of the Manufacturers' Association. The meeting then adjourned until 2:30 o'clock. The reports of subsequent sessions of the American association will be published in the Street Railway Journal for Oct. 27.

INVITATIONS FROM THE SCIOTO VALLEY TRACTION COMPANY

Through the courtesy of President Frank A. Davis, of the Scioto Valley Traction Company, the courtesies of that line were extended to the members of the four associations during convention week. Transportation was furnished to any point on the lines on application to the ticket office at Rich and Third Streets. A large number of delegates took advantage of this offer.

DIRECT PHILADELPHIA-NEW YORK SERVICE ABANDONED

The through service over the Trenton & New Brunswick Railroad and the Elizabeth & Raritan River Street Railway to Elizabeth, and over the North Jersey Street Railway from that place to Jersey City, has been discontinued, after being in operation since May, 1904. Cars will be run to New Brunswick every hour, and connections made there for intermediate points to Jersey City. The fare between Trenton and New Brunswick has been reduced from 80 cents excursion to 60 cents, so that the Trenton & New Brunswick Railroad is now receiving less than one cent per mile, counting from the center of the city. The only other lines out of Trenton on which the fare is less than one cent per mile are to Lawrenceville and Princeton, N. J., and Yardley and Newton, Pa. The Trenton & New Brunswick travel is largely through business, and the number of people hauled during the four years that the road has been in operation has exceeded all expectations.

ANNUAL ADDRESS OF THE PRESIDENT OF THE AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION

DELIVERED BY W. B. BROCKWAY,

At the Columbus Convention of the Association on Tuesday, Oct. 16, 1906

GENTLEMEN:

The prime object of a president's annual address in an association of this character is, it seems to me, to give the executive officer a formal way in which to set before the association the views he may have, based upon the experiences of the term of office of the work and the future of the association. From that point of view I wish to take your time this morning to say some important things and to make some explanations.

Most properly, the first words I wish to say to you are such as shall express my appreciation of the honor you conferred upon me last year by electing me as your president. I was deprived, by my absence, from saying my thanks at the time of the election and I should take the honor lightly indeed if I did not, at the first opportunity, say that your confidence, coupled with the honor of the position, has touched me. It is a very honorable thing to be president of this association. It has much more than repaid me for any work I have done in the past and I thank you sincerely.

It is a peculiar and pleasant coincidence that this annual meeting of this association should be held in the State of Ohio. This, as you know, marks the end of the first decade of our work together, and those of us who were present at the first meeting in Cleveland must look around this room this morning with honest feelings of pleasure and pride. The greetings contain a sentiment it is good to feel. We have all these years been on business bent; striving for the better ways and clearer light to help us do more valuable work for others and so for ourselves. Yet there has grown up between us a friendship that is deeper than business and its methods warrants; a friendship as close and real, it seems to me, as it is possible to build under any circumstances.

It takes but a moment to remember the complete harmony of the years. Not an action, not a thing has occurred to mar in any way the steady purpose and work within the association. That of itself is remarkable enough from the human standpoint, but when one reads the list of accomplishments and realizes the tremendous force gathered by some of the things done, how the effect has spread and widened, until now standards have been set up, against which things and conditions are measured it becomes more remarkable still. Add to that the present standing of the association and there develops an associate history of which we must be proud, and we all have a right to participate in the pride because we have all helped.

It is a pleasurable duty I am performing by thus briefly putting before you a reminder of the results of ten years' work. At such a time as this we should, it seems to me, look both backward and forward, that the experiences gained may be used, so far as they may be, in the future.

The year just closed has been a very busy one for the reason that it is the first under the new plan of consolidation of the associations. Everything has had to be rearranged and started off on a new track, even though the object desired to be obtained was the same as before. In this work I have had the cordial, helpful advice and assistance of the executive committee, and especially have I called Mr. Young into conference many times. He is located so near to New York that he has had to bear the brunt, and he did not fail me once.

The duties of president made me your representative upon the executive committee of the "American" Association. I wish to report that I have attended one meeting in New York and one in Columbus and have assisted all through the year, as far as I was able, to get the new office well started. From my experience during the year with the new plans of the American and the other associations it is my opinion that the work of the associations, as now planned, will be sure to bring good results to the operation of electric railways in all branches. The new secretary, Prof. B. V. Swenson, of the American Association, I consider particularly well equipped for the duties and only good can come from the present methods.

Over and over again during the year there have been evidences that the plan of amalgamation will not work to the disadvantage of our association. It is true we have not had all the money we desired this year, but we have managed to carry on all of the important duties, although to do this we have had to use practically all of the surplus left over from the past year. We have assurances, however, that when more prosperous times come to the American Association the surplus will be made good to us. In this connection I wish to explain that at no time have we been refused all the money we needed. We have simply done all we could to co-operate with them and have done all we could to tide them through their first year. It should be clearly remembered that for the present co-operation is needed from all sources to the end that a great association may be built up which will in every sense be representative of the large interests for which we stand. As the American Association grows so shall we. As it prospers, so shall we. As its membership widens we shall be reaching more companies also. And even though we are in every respect a separate, distinct and self-guiding association, we have much to gain by the prosperity of that body.

The problem of dues and the collection of them has slipped from among our problems, but the obligation to work for membership is still upon us. It is fixed that we grow with the growth of the whole, and growth means a wider opportunity to all the associations. Under present conditions a new member attracted by one of the associations is an addition to all of the associations, and each member will soon learn to take advantage of all the opportunities of membership. All in all, I believe we shall gain by the new methods unless some element not experienced this year shall enter into the arrangemnt. I would like to suggest that all accountants shall take advantage of the associate membership offered by the "American" Association. It will put you in touch with the operating branch of the association work and will bring to your desk for your own use a copy of the annual report. This provides an opportunity to read and digest the work of other departments as well as this. To President Ely should go full appreciation of the honest and cordial way he has met us and our plans this year. He has been both able and considerate, and a very large measure of the present harmony is due to him.

It is natural that while blazing new trails this year a constant mindfulness of the future of the association should have brought out into clear vision some of the ideas of long ago, and at the same time given expression to new ones. I wish to take your time for a few minutes to point out some of them to you as I see them.

The date and some of the other details of the arrangements for this convention have been rather difficult to arrive at in a way wholly satisfactory to this association, which leads me to say that many of you will remember I have always been of the opinion that our meeting annually at the same time and place with the other associations is not the most satisfactory plan for us to follow. I am fully cognizant of all the arguments on both sides of the question, and I am still of the opinion that at some early day this association must hold its annual meeting at its own time and place; that it may follow whatever plan it may desire or find proper, without having, at every point, to square up to the other association, so as not to affect them or let them affect the plans we find in our judgment to be the best for us. Those of you who have attended most of the meetings of this association will remember that at only five out of eleven meetings have we been able to deliberate in the ways we know to be best for accounting subjects, and one of the five satisfactory times was that one when we did meet alone at our organization meeting. In my opinion, the argument of railroad fares should be eliminated. Our work is now important enough that the railroad fare does not enter into the consideration. But I do not propose to here argue the matter because it is familiar to you, but will leave it by again expressing my belief that the best interests of all concerned will be advanced by a separate time and place of meeting. I hope the time will not be long until the proper action is taken to make our meetings in the spring of the year, or such other time as our own membership shall find convenient.

Other matters which will have their large bearing upon the future welfare of the association are—the care with which you select your officers, and the extent to which each member lets himself "go" in the association life. It is impossible for any organization to produce good results or even to do much more than keep alive if the members composing it are not active in it, even though they are sympathetic with its aims. And, also, it is not possible to succeed if the officers are not always keenly alive to the welfare of the association that honors them. This association has been wonderfully successful in this respect in the past, and I believe will continue to obtain enthusiasm with each new list of officers, but experience seems to show that we should not select the members for our executive committee entirely from a geographical point of view, although the place of

residence may be considered. A compact committee may be more easily brought together for real work than can one selected from all over America. A man's selection upon the committee, and as an officer, should not be taken merely as a compliment, it means work, and only work can bring entire success to the association. Even with a hard-working executive committee, success cannot be gained unless you select for your president and your secretary men of positive convictions and character. Neither geographical location of residence nor association politics should be allowed to enter into those positions. In saying this I do so entirely upon the platform that the association will be kept in continually capable working condition and not allowed to slow down nor become too self-satisfied. It will be found comparatively easy for us to lose in a short time much of the gain we have made in ten years' work as an association, and the best way to safeguard that possibility is to be careful in selecting your officers. There is an old saying that "It is better to be sure than to be sorry." I think it may be used in this connection.

In regard to the presidency, it is my personal opinion that any gentleman whom you desire to so honor should be selected, not only for the work you expect him to do, but also as a compliment for the work he has already done for the association. In other words, it should go to one who has shown by his interest and actions that he has the welfare of the association at heart and is willing to put in one more hard and busy year to help the movement along. I am further convinced that the presidential term should be limited by an unwritten law to one year. There will always be some one eligible for the position, and I do not think it will be fair to ony one to ask him to give up so much of his time for two years. Understand me rightly when I make these suggestions; they are only my personal opinions, but you have in the past ten years kept me in the position of either secretary or president, and I am now giving you some of the opinions which are mine after those ten years.

And I want to impress upon all who hear me and all who shall read these words, that this is a mutual association. It is put together for the mutual give and take from each to each, the large and the small helping and encouraging each other. The fact that the association is a mutual one is where every member comes in. It is up to you, each one of you, to decide if you want to give or take, or both. The future of the association, and of your profession, in a large measure rests upon how much each individual helps this movement with his own little or big push. I believe, positively, that as you work for the interests of this association, so will you benefit in knowledge and other ways. And as you work so shall the association grow, and as it grows so shall it, with good management, do a work which must leave its imprint upon our profession and our business, and upon each of us.

It rests wholly with you, gentlemen, what shall become of the next ten years' work. The first ten have passed rather quickly and the next ten will do the same. A correct reading of the future would be interesting, but what is the gain by it? The element of chance and personal hard work would be lost. They both go far to explain success. At any rate we should keep constantly before us that we can make this association greater and more useful than it is now. There is plenty to do and to work for in the way of principle. It rests wholly with you.

Now and then since the completion and adoption of the present standard classification of accounts and the standard form of report, the thought has been expressed that the important work of the association was about over and the organization would soon become a formality and live a monotonous existence. To those who have closely followed the life and work of the association this is an incorrect conception. We have felt that there is a long and useful term of years ahead and that carefully and thoughtfully managed, together with the growing confidence placed by the financial and operating interests in the results of the deliberations of the association, the very high standard attained would be continued.

However, as a partial answer to the doubt referred to, your executive committee has arranged a program this year along unique lines. There is no set paper upon any subject heretofore discussed, and the titles selected are to be handled by gentlemen who have not previously appeared before us in that light. This, understand, is no reflection whatever upon our previous programs, because the same condition has existed before, but we were actuated by a desire to handle new subjects from new standpoints and also re-enthuse everyone into confidence in the future. It must be remembered, though, that new subjects are not always desirable when old subjects remain undecided, and we have one such unsettled matter before us. I refer to the attempt to standardize shop reports. For various reasons that has lain dormant for two years and should have been attempted again this year, but owing to the enforced change in the personnel of the committee, and also due to the husbanding of our financial resources, it was decided, after consultation with Mr. Adams, president of the Engineering Association, to defer the matter for another year. I shall ask you, therefore, to take action at this meeting to express your wishes to the incoming administration, that they may be guided therein.

Two of the papers to be read to and discussed by you, have a direct and far-reaching effect upon the capital expenditures and provisions of our companies. Neither of the subjects can be completely digested at one convention. Especially does this apply to the whole subject of depreciation. The importance and the confusion of honestly opposed opinions of the reasons for and the scope of depreciation is such that it has long been recognized some steps should be taken to clear the atmosphere so it might be understood aright. If depreciation in all its phases and various percentages is right, then it is just and fair that it should be honestly recognized and provision made accordingly. If, on the other side, it is not right, then that should be understood and the issue closed. If, again, it is partly right and partly wrong, the times and extent when it is right should be learned and the times and extent when it is not right should be set out, that all may be informed. There is no question that the doubt about it has magnified both sides of the attitude toward it, so this movement of discussion will do much to straighten out hazy and half knowledge of the problem. It should be clearly understood that the element of conditions enters somewhat into the treatment, in practice, of depreciation. This being so, it is high time that those conditions which affect it should be set forth and understood.

Your executive committee has very wisely, I think, set limits into which this year's discussion shall be kept. Yet it will be appreciated that the limits contain space enough so that the discussion may move freely and be productive of good. There has been no desire to slight in any way the whole of this problem by the restrictions placed about this year's discussion of it. But your committee thought the whole subject is so large, and so easily can the discussion be turned into what is known as a "water haul" by attempting the whole subject at once, that by directing our attention to one phase only, we would make definite progress with this opening wedge.

It has been clearly recognized that this discussion will last several years and we do not wish to have any part of it spent in lost time. Without a doubt, at the end of the day's discussion we shall be in a better position to talk of future plans than we are to-day; at any rate a start is made and I am sure we should soon be in a position to know what it is all about and why anyone ever thought of it in the first place. The same success should follow this as has followed our other large undertakings.

Both subjects relating to capital expenditures on our program have great importance when we look ahead into the future, and there is no doubt we have arrived at a point where we must give more serious attention to the future. There are many specious and trite sayings that the future will take care of itself, and that the stockholders who take the present risk should also get the present gain, and many other crisp and jingling sentences of a like tenor. We have all heard them and some of us rather half believe half of them, but above all it is for the accountant to keep his head clear and his blood cool, that he may place his advice and his practices into the right course, to play searchlight into the future for those who are the engines and the pilots of the business we represent.

Therefore, our program this year is particularly timely. It is no small matter to select and account for the expenditure of capital, and it is a much, a very much, more difficult subject to reduce those charges after the expenditure is made. Believe me when I say that in a large measure the future of the industry depends upon these two subjects, and many of you will agree with me that that future is not so very far away either. It cannot possibly be long, as great events measure time, before those corporations which have allowed themselves to arrive at the end of the highway called capitalization, will and must face the tremendous problem. With terminating franchises, a road wearing out and a capitalization per track mile of many hundreds of thousands of dollars, that chapter will be written.

What about the stockholders when that time comes? What will be done when the motive power changes again? What will be the security supporting long term bonds under such conditions?

It is a time we must face and we must do much thinking in advance. There is a struggle coming and you and I shall participate in

it, when a mastery of the subject which shall bring that time about shall stand us on the right side. I do not pretend to prophesy what the subject will be, but if you follow the trend of current events seriously it will some day show itself. The two papers and discussion on the accounting for expenditure of capital and the reduction of it after expenditure, will be part of it I believe.

The other subject we are to discuss is distinctly operating. The use of curves in expressing statistics is both old and new, yet they have never been brought out to their full usefulness. Everything which promises to be useful should be tested, and if found correct, used to demonstrate to the operating official what he has accomplished. He is more than willing, he is anxious to find and make use of anything that will put him closer to his problems. Statistical curves are distinctly within the work of the accountant, as is any work of a statistical nature.

We have never discussed this exact subject before and there are few experts in the work. We have been fortunate this year to get the experience of the gentleman who most uses them, and your committee hopes to start the work into more general practice, believing that it is another distinct help to the operation. This association put the car-hour, the one most successful unit, into practice, and if the use of curves, assuming them to be as useful as they promise, will help to point out other phases of operation, it will be another good accomplished.

This explanation of what is hoped and expected of the program of this convention, is made that it may be understood the program was arranged with a definite plan in view, and not simply strung together in order to have something to talk about. If the expectations of your committee are realized the association and those present will have gained something worth while.

The association has had to witness the retirement of one of its past presidents from the electric railway business this year, to take up work in another field. I cannot let this opportunity pass without, so far as I am able, expressing in this public manner a very sincere personal regret that this change has occurred. I refer to H. C. Mackay, and I am sure everything I can say and feel at his withdrawal will be repeated by each one of you. The record of Mr. Mackay is so well known that I need not recapitulate it here, but this association has gained some of its accomplishments from him and he deserves all and more than we can give him in the way of thanks and respect. I recommend a resolution that he be elected an honorary member of this association, with full privileges of the association for all time.

Because of the resignation of Mr. Duffy from the committee on standard classification, the committee on standard form of report and the committee on international form of report, I have appointed William F. Ham, chairman of the committee on standard classification, and Elmer M. White, to be a member of that committee. Henry J. Davies succeeds Mr. Duffy as member and chairman of the committee on international form of report. The vacancy in the committee on standard form of report has not been filled.

Frank R. Henry has succeeded Mr. Mackay in the committee on standard classification, and Fred E. Smith has been appointed a member of the committee on international form of report, to succeed me.

These many changes are important and mean much in the coming work.

And now I come to what, in my mind, is a very important subject. I want to say a few words to you about the accountant and his duties.

The old time, when we were bookkeepers and no more, has passed, I believe, permanently away. So much more is demanded of us and confidently expected that we measure up to the requirements, that I cannot refrain from mentioning the matter, even at the risk of being long in this address. We are certainly at this present time in a much different place than we occupied ten years ago. There is no doubt that greater demands are made upon us, as a class, than there were at that time. We are not mere tabulators of figures any more. We have become in a large measure business advisors, and one of the five senses making up the whole of the business body. Therefore, it is well to give consideration to our needs in filling our duties up to which we must measure.

The necessity of a broad mind is so apparent that it must be recognized. The nature of the work we perform tends to train us into hair splitting and petty detail, and if we permit full swing to that tendency we must each find ourself in such a narrow way that the larger and more helpful work must be performed by someone else, although it is quite within our present duties and our capabilities. There are much greater things than making figures balance. Don't forget that. We must learn to analyze, to pull apart and compare. Not alone the accounting systems, but the financial plans of our own and other companies. Banking methods and the trend of money; the corporation and taxation laws of many States; the procedure followed in reorganization, and many other things which will readily occur to you are now required. These make it necessary that we must read and study much and patiently, that we may come up in the fullest sense to our opportunities.

Confidence in figures is frequently helped by confidence in the accountant; therefore, what we really are is of inestimable value in the place we fill. No one will contradict me when I say that just now one of the most needed elements in business is confidence. You are the only one who can fix that for yourself.

We must also keep up with the times. The easiest thing we can undertake is to get in a rut, and it is the most dangerous to our future. Keep up with your office and the office up to the times, but by that I don't mean to adopt every idea presented to you, but be informed about it and think some out yourselves. Get away from a small conception of the duties of the office and fill larger ones. As we do so shall the larger ideas be considered as a part of the requirements of a modern accountant.

Thus, briefly, do I throw out an idea I hope we may all consider, and as a recapitulation I make use of Shakespeare's lines in Hamlet:

> And these few precepts in thy memory:
> Look thou character. Give thy thought no tongue,
> Nor any unproportion'd thought his act.
> Be thou familiar, but by no means vulgar.
> The friends thou hast, and their adoption tried,
> Grapple them to thy soul with hooks of steel;
> But do not dull thy palm with entertainment
> Of each new-hatch'd, unfledg'd comrade. Beware
> Of entrance to a quarrel; but, being in,
> Bear't, that th' opposed may beware of thee.
> Give every man thine ear, but few thy voice;
> Take each man's censure, but reserve thy judgment.
> Costly thy habit as thy purse can buy,
> But not express'd in fancy; rich, not gaudy;
> For the apparel oft proclaims the man;
> Neither a borrower, nor a lender be:
> For loan oft loses both itself and friend,
> And borrowing dulls the edge of husbandry.
> This above all,—to thine ownself be true;
> And it must follow, as the night the day,
> Thou canst not then be false to any man.

ELECTION OF OFFICERS OF THE AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION

(Received by Telegraph.)

At the meeting of the American Street and Interurban Railway Association, held on Friday Morning, Oct. 19, John I. Beggs, president of the Milwaukee Electric Railway & Light Company, was elected president for the ensuing year; vice-president, C. G. Goodrich, vice-president and general manager of the Twin City Rapid Transit Company; second vice-president, James F. Shaw, president of the Boston & Worcester Street Railway Company; third vice-president, Arthur W. Brady, president of the Indiana Union Traction Company. The executive committee is composed of the officers of the parent association and the presidents of the affiliated associations as announced on page 736 of this issue.

Only a short time remains now until all that is left of the old horse-car line leading from Santa Monica, Cal., to the Soldiers' Home will be but a memory. The Los Angeles-Pacific Railway Company, which has been operating the road during recent years, has abandoned its franchise and the rails are being torn away to make room for a magnificent boulevard that is to occupy Nevada Avenue for its entire length. This street railway line, one of the few remaining horse-car roads in Los Angeles County, was built nineteen years ago. The franchise for the Santa Monica & Soldiers' Home Railroad was granted in 1887, and upon the completion of the road there was a great banquet at the Arcadia Hotel. The franchise was issued to W. D. Vawter. Local people financed the road and operated the picturesque line between the eucalyptus-lined avenue until it fell into the hands of the Los Angeles-Pacific Company. Since the construction of the trolley road to the Home by way of Brentwood and Westgate the necessity for the Nevada Avenue route has passed. The Brentwood line will soon be double-tracked for the entire distance. The double track will extend along Ocean Avenue for its entire distance, and along San Vincente Boulevard to the Soldiers' Home.

FINANCIAL INTELLIGENCE

WALL STREET, Oct. 17, 1906.

The Money Market

The most important development in the monetary situation during the past week has been the decided strength in discounts abroad. The Bank of England advanced its minimum rate to 5 per cent, while the open market rates at the other principal centers have ruled materially higher. The strength of the foreign money market has been reflected in a sharp advance in rates for sterling exchange here to a point that precludes further imports of gold from Europe, and has also resulted in the shifting of a considerable amount of our indebtedness from London to New York. Otherwise the change in the foreign situation has not materially affected local conditions. Thus far our bankers have been able to meet their maturing obligations abroad, and no doubt they will be able to do so as they mature, as it is expected that our exports of grain and cotton will be more than sufficient to pay off these obligations, and to prevent a rise in exchange rates to a point that would necessitate the exportation of gold. As a matter of fact the supply of commercial bills during the current week have been sufficient to cause a reaction of about 80 points in sterling from the recent high level. The situation at home has ruled somewhat easier, and rates for both call and time loans have sustained further recessions, notwithstanding the heavy transfers of funds from New York to the principal inland cities for crop moving and general business purposes, and the heavy shipment of gold to Canada. The demand for money for stock speculation has been considerably smaller, owing to the comparative inactivity in the stock market. The inquiry for money has been largely for three months, and the rate for that maturity has ruled firm at 6 per cent. For the other periods offerings have been rather liberal, money for five and six months being practically unlendable at 5¾ per cent. Money on call has ranged from 4 to 3 per cent, the average rate for the week being about 3½ per cent. Since Sept. 10, the date when Secretary Shaw's relief plan went into effect, our banks and bankers have secured in Europe and Australia about $45,000,000 gold, which, together with the special deposit of about $26,000,000 Government funds in the national banks has placed the local institutions in a better position to meet the heavy drain being made upon their resources. The bank statement, published last Saturday, was more favorable than expected. Loans increased $13,326,600, due in part to the shifting of loans from Europe to New York. Deposits were larger by $19,437,300. Cash increased $8,460,000, but as the reserve required was $4,859,325 more than in the preceding week, the surplus reserve was increased by $3,601,275. The surplus now stands at $13,024,400, and compares favorably with the reserve held in corresponding periods of former years. In 1905 the surplus was $10,211,400; in 1904, $15,433,250; in 1903, $17,433,250; in 1902, $5,608,250; in 1901, $15,465,775, and in 1900, $4,465,925.

The Stock Market

The stock market has been dominated by monetary and political influences during the week, and the lower price level is a natural result of the rather unfavorable change in the situation. The advance in the Bank of England rate of discount was followed by a sharp upward movement in exchange, thus arresting the import movement of gold to this side. The higher money rates abroad also resulted in a shifting of accounts from Europe to New York, and this was largely responsible for the increase in the loans of the New York City banks shown in the last statement of the clearing house institutions. Otherwise the strength in the European markets has not been reflected in the local money market, as it is generally believed that our exports of cotton and grain will be more than sufficient to meet our indebtedness abroad.

The political situation is a deterrent to any pronounced initiative on the long side of the market, and the dominant interests are not encouraging speculative activity at the present time. While this may be based on sentiment, it is backed by the feeling that the election of the Democratic and Independent League candidate for Governor would be followed by unfavorable developments affecting the market, and more particularly the shares of the public service corporations. Aside from money and politics there has been an absence of any developments calculated to stimulate speculative operations for either account. The real significance of the iron ore deal is not yet fully appreciated, but when the election has become history this deal will likely be given greater prominence, and other plans of importance will be disclosed. Technically the market position is sound. Stocks are concentrated in strong hands, and, barring accident, there does not appear to be any good ground on which to base expectation that the large holders will attempt to distribute their stocks. Speculative interest on the part of the public is running into mining stocks rather than to railroad and industrial securities. The continued strength of the copper metal market and the large earnings of all the copper companies is sufficient warrant for the movement in the copper stocks, and as a majority of these sell at low prices, the public is responding to the invitation to participate. The strength of United States Steel has been one of the features, but there was heavy profit-taking on the advance. Attention is being given to the fact that the November interest and dividend payments will be large, and that preparations to meet these will be made during the second half of the month, with the probability of a flurry in the money market in the closing days of October. Speculative sentiment is more optimistic than otherwise, but there is noted an undercurrent of conservatism, and the belief in some quarters that the present level of prices has pretty well discounted all the good news past and prospective.

The local traction situation is practically unchanged, but the shares of these companies are under the influence of political possibilities. The election of the Republican candidate for Governor would remove all apprehension of unreasonable interference with these companies and would naturally stimulate a more confident feeling regarding this class of stocks.

Philadelphia

The trading in the local traction securities was rather more active in the past week, and although prices at times have displayed more or less irregularity, the general trend of values was towards a higher level. Interest in the market centered to a great extent in the shares of the Lehigh Valley Transit Company, both of which advanced sharply on reports of large earnings. The common stock, after selling at 12¾, advanced to and closed at 16½, about 3000 shares changing hands, while the preferred, after declining a fraction to 23, rose to 27¾, and closed within a small fraction of the highest. About 3000 shares were dealt in. Philadelphia Rapid Transit was active, upwards of 5000 shares changing hands, from 28¾ to 28¼ and back to 28½. Union Traction displayed firmness, about 600 shares selling at 64½ and 64¾. Odd lots of American Railways brought prices ranging from 52 to 51½, and small amounts of Philadelphia common and preferred brought 49. Philadelphia Traction was steady, with sales at 98 and 97⅞. Other transactions included Railway Companies General at 6¾, Consolidated Traction of New Jersey at 78, United Companies of New Jersey at 56, and Reading Traction at 37.

Baltimore

The feature of the Baltimore traction market was the strength in the United Railway issues, nearly all of which scored substantial advances. The free common stock sold to the extent of 400 shares at 15 and 15¼, and about 1500 shares of the deposited stock brought 15¼ and 15½. The 4 per cent bonds rose from 88¾ to 89⅛, on purchases of about $50,000, while the certificates representing income bonds deposited advanced from 68¼ to 70, on the exchange of upwards of $100,000. The free incomes sold at 69 for $13,000. The new refunding 5s sold at 88¾ and 89 for $33,000. Other sales were: City & Suburban 5s at 110½, Norfolk Railway & Light 5s, $11,000 at 99½ and 100¼; Norfolk Street Railway 5s at 108 and 107¾, and Virginia Electric Railway & Development 5s at 100.

Other Traction Securities

It is expected that a meeting of the representatives of the Chicago traction companies will be held this week, and that an agreement will be reached upon the plan for carrying on the negotiations with the city of Chicago. The Eastern interests are said to be satisfied with the present situation in Chicago, and a settlement of the matters under discussion is looked for. Trading

in the Chicago traction issues during the week has been very quiet. Metropolitan Elevated preferred sold from 68 to 66½ for small amounts. Chicago & Oak Park Elevated brought 5⅝ for a small amount. Union Traction common changed hands at 4⅞, and the preferred sold at 17¼. A small lot of Chicago City Railway sold at 140, and West Chicago sold at 29. The Boston market was very quiet but firm. Boston Elevated declined from 155 to 153, but subsequently recovered all of the loss, about 800 shares changing hands. Massachusetts Electric advanced from 18 to 19 on purchases of about 1500 shares, and about 800 shares of the preferred sold from 69½ to 72 and back to 71. West End common brought 94½ and 94¾, and the pr erred sold at 108.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Oct. 10	Oct. 17
American Railways	51¾	52
Boston Elevated	153	155
Brooklyn Rapid Transit	78	79¼
Chicago City	a150	—
Chicago Union Traction (common)	4¾	4¾
Chicago Union Traction (preferred)	17½	16¾
Cleveland Electric	—	—
Consolidated Traction of New Jersey	77	76
Detroit United	97	*95½
Interborough-Metropolitan, W. I.	36⅜	37⅝
Interborough-Metropolitan (preferred), W. I.	76⅛	71½
International Traction (common)	—	60
International Traction (preferred), 4s	—	79½
Manhattan Railway	144	143
Massachusetts Electric Cos. (common)	18	18¼
Massachusetts Electric Cos. (preferred)	69½	70
Metropolitan Elevated, Chicago (common)	26	26
Metropolitan Elevated, Chicago (preferred)	66	66
Metropolitan Street	104	105
North American	92⅞	91¼
North Jersey Street Railway	27	27
Philadelphia Company (common)	—	49
Philadelphia Rapid Transit	28	29
Philadelphia Traction	97¾	97¾
Public Service Corporation certificates	67	66
Public Service Corporation 5 per cent notes	96	95
South Side Elevated (Chicago)	93	93
Third Avenue	125	125
Twin City, Minneapolis (common)	113¾	112½
Union Traction (Philadelphia)	64½	64¾
West End (common)	—	—
West End (preferred)	—	—

a Asked. * Ex-dividend.

Metals

According to the "Iron Age," the enormous pressure upon the iron and steel manufacturing plants is increasing rather than decreasing, and is spurring the management to unusual efforts. Work at the highest pressure is assured all along the line for the first half of next year, and in some lines the commitments run well into the second half. Increasing interest centers in the supply of raw material for next year and the prices demanded for them. Considerable sales of lake ores are reported at an advance of 50c and as high as 75c a ton above this season's figures. Steel billets continue scarce all over the country.

The demand for copper metal continues urgent, and producers are taxed to their utmost capacity. The extraordinary demand has been reflected by an advance of 1¼c a pound in electrolytic, to 21½ to 22 cents. Lake advanced to 21¾c to 22½c, and castings were 21c to 21¼c to 21¾c a pound.

NEW OFFICE BUILDING OF THE BIRMINGHAM COMPANY

The offices and headquarters of the Birmingham Railway, Light & Power Company, of Birmingham, Ala., have been moved to the building at the corner of First Avenue and Twenty-First Street. Every department has quarters of its own, and the lay-out generally is considered a model one. On the first floor there is a display room, about 25 ft. x 100 ft., which is used by the light and power department. In the rear of this room there is a model kitchen, showing all the devices for using gas and electricity to advantage. In addition to this equipment it is proposed later on to install a model bath room with various heaters and other electrical devices. The demonstration room proper is on the third floor. Here cooking and lighting with gas and electricity, and in fact everything pertaining to the use of gas and electricity for domestic purposes are shown and explained. In the rear on the first floor are the offices of George H. Harris, superintendent of the street railway department, and of George F. Atkinson, superintendent of transportation, as well as the offices of the claim agent. The second floor in front contains the offices of President Robert Jemison and Vice-President J. A. Emory. The director's room adjoins Mr. Jemison's office. The remainder of that floor is taken up with the offices of the auditor, secretary and the heads of the gas and electric departments. Besides the demonstrating room on the third floor, to which reference has already been made, there are the offices of the purchasing agent and the meter department. The offices of Ford, Bacon & Davis, engineers of the company, occupy the fourth floor. The private offices are in front and the draftsmen are in the large room on the Twenty-First Street side of the building. In the basement are the workshops and offices of the steam heating department.

THE CLEVELAND & SOUTHWESTERN COMPANY'S NEW SHOPS

At a meeting of the directors of the Cleveland & Southwestern Traction Company recently a committee was appointed to agree on plans for the equipment of the new repair shops, which will be located outside of Elyria, on the western division. The committee will decide whether to carry out all of the plans immediately and spend $75,000 in the buildings and equipment, or to spend only $50,000 in the improvements for the present. In any event, the layout will be very complete. The old shops at Rockport will be retained to take care of some of the light work for the southern division so that it will not be necessary to send all the cars to Elyria. This improvement will augment an expense of $25,000 spent in track improvements during the past few months and $250,000 spent for cars and equipment. The company is now securing estimates on the cost of installing an additional turbine and boilers in its Elyria power station to take care of the needs of the Cleveland, Ashland & Mansfield extension to the system, which is now well under way. The various physical improvements and the improvements to the service have greatly helped the business of the company, as evidenced by the fact that the earnings have increased on an average of $8,500 a month thus far this year. A considerable portion of the improvements is being made out of the earnings of the company, and while this method of financing has eliminated all dividends, the stockholders are showing no disposition to complain.

PETITION FILED AGAINST NEW YORK, NEW HAVEN & HARTFORD IN MASSACHUSETTS

The right of the New York, New Haven & Hartford Railroad Company to engage in the street railway business in Massachusetts is again questioned in that State. Attorney-General Dana Malone, in his own name and in the name of Commissioner of Corporations William R. Trefry, has filed four informations in the Supreme Court of Massachusetts, two of them against the New York, New Haven & Hartford Railroad, one against the Worcester & Webster Street Railway, and one against the Webster & Dudley Street Railway Company. It is charged by the Attorney General in the proceedings against the New Haven road that the company has taken and held stock, dividends and bonds, and has guaranteed the payment of the bonds of the Worcester & Southbridge, the Worcester & Blackstone Valley, the Worcester & Webster, the Webster & Dudley, the Berkshire and the Springfield Street Railway Companies. The proceeding is brought under Chapter 372 of the Acts of 1906, under which a corporation can be restrained from exercising a franchise and privilege not authorized under its charter.

In the action against the street railway companies a decree for the dissolution of the corporations is asked under Section 58 of Part 3 of Chapter 463 of the Acts of 1906 on the ground that the companies have violated the terms of their charter by permitting the acquisition of their stock by the Consolidated Railway Company, a foreign corporation, which is not authorized by any law of the Commonwealth of Massachusetts.

REPORT OF THE NEW YORK CITY RAILWAY COMPANY FOR THE YEAR ENDED JUNE 30

On Monday, Oct. 8, as noted briefly in the Street Railway Journal last week, the New York City Railway Company issued its pamphlet report for the year ended June 30, 1906. The income account compares as follows:

	1906	1905
Gross receipts	$21,937,944	$20,888,124
Operating expenses	12,624,783	12,871,423
Net earnings	$9,313,161	$8,616,701
Other income	124,744	444,603
Total income	$9,739,905	$9,061,304
Tax, rent, interest, etc.	*11,950,903	11,858,246
Deficit	†$2,212,998	$2,796,942

*The special franchise tax which is in litigation, is not included. The amount of this tax for the fiscal year, based upon the assessment for the calendar year 1905 as claimed by the State, and after deducting the various franchise payments to the city which the company is entitled to deduct, and also certain reductions conceded by the State, is approximately $537,000. Proceedings are now pending which are expected to result in a substantial reduction in this amount.

†This deficit will be further increased by the amount of the special franchise tax when ascertained.

MILEAGE AND TRAFFIC STATISTICS

	Electric	Horse	*Total
Borough of Manhattan	223,244	92,532	315,776
Borough of Bronx and Westchester Co.	201,030	.....	201,030
Total	$424,274	$92,532	$516,806

*Includes milcage not operated and tracks in houses.

PASSENGERS CARRIED

	Revenue	Transfer	Total
Borough of Manhattan	$391,354,877	$17,863,866	$569,994,743
Borough of Bronx and Westchester Co.	49,145,560	23,707,097	72,852,657
Totals	$440,500,437	$202,346,963	$642,847,400

The general balance sheet as of June 30, 1906, compares as follows:

ASSETS

	1906	1905	1904
Construction, equipment, lease and franchise	$101,816,300	$160,275,544	$145,583,380
Additions and betterments, leased lines.	23,710,818	23,232,630	23,040,068
Deposited with trust companies	626,196	152,414	.....
Investments	11,503,623	10,942,248	5,244,687
Material and supplies	897,288	976,878	1,231,188
Cash	690,046	900,587	1,231,188
Cash to pay coupons and rent	1,217,897	1,057,696	1,136,178
Cash to redeem bonds	99,000	108,240	160,000
Cash on deposit with New York City..	2,500	2,500	2,500
Notes receivable	1,494,099	1,494,099	88,725
Accounts receivable	682,680	783,906	592,934
Met. Sec. Corp. sub. to N. Y. City Ry.	6,379,000	8,052,000	8,052,000
Accrued accounts	15,931	16,750	13,893
Prep'd and undistributed accounts	644,192	565,096	419,767
Central Crosstown construction fund	814,821	814,349	.....
Totals	$150,594,391	$149,659,824	$187,612,568

LIABILITIES

Capital stock	$61,404,000	$60,503,100	$72,111,803
Funded debt	50,996,000	50,810,000	92,332,000
New York City Railways ten-year note.	1,761,000	660,000	660,000
Central Crosstown two-year notes	.....	.....	2,250,000
Real estate mortgages	950,000	950,000	950,000
Metropolitan security Company	7,553,500	9,556,800	9,556,800
Notes payable	*23,524,090	20,581,546	850,000
Accounts payable	1,469,720	1,926,116	1,483,209
Coupons and rent due and unpaid	1,217,897	1,059,696	1,136,177
Employees' deposits	23,702	27,714	28,294
Unclaimed wages	13,979	10,704	5,770
Transfer tickets	7,090	6,296	2,489
Accrued interest and rent	1,950,096	1,924,802	1,896,370
Accrued taxes	1,745,584	1,485,344	1,296,023
Wages, etc.	.....	.....	86,689
Central Crosstown construction account	814,821	814,349	.....
Reserve for replace	205,638	125,942	.....
P. & L. def.	3,042,727	782,585	3,279,082
Totals	$150,594,391	$149,659,824	$187,612,568

*Includes $15,240,752.99 due by the subsidiary companies of the Third Avenue Railroad Company to the Third Avenue Railroad Company, and $6,936,000 due by the New York City Railway Company, Union Railway Company, of New York City, and Metropolitan Street Railway Company to the Metropolitan Securities Company. There has been eliminated from the liability "notes payable" and from the asset "notes receivable" $3,206,710.77 of notes payable of companies in the system owned by other companies in the system.

In his report President H. H. Vreeland says:

The operations of the past fiscal year cover a full twelve months' period of competition with the subway; whereas during the preceding year the subway was in operation but eight months and then only over a portion of its present system. The increase of almost 5 per cent in the gross earnings over the previous year realizes the expected recovery and adjustment of the surface railroad traffic under new conditions, indicating that the increase in the short-haul business is rapidly overcoming the loss of long-haul traffic that has gone to the subway.

The increase of $353,358 in operating expenses is chiefly due to larger expenditures for maintenance and improvements of track and roadway and of equipment.

The fixed charges include the increase in the annual rental payable under the Third Avenue Railroad Company lease, which for four years from April 13, 1906, is at the rate of 6 per cent upon the Third Avenue Railroad Company stock, instead of 5 per cent as was the case for the preceding two years. A slight decrease in interest has resulted from the refunding of the following bonds by an issue of Metropolitan Street Railway Company 4 per cent refunding bonds reserved for that purpose; $1,000,000 second mortgage 5 per cent bonds, Broadway Surface Railroad Company; $50,000 first mortgage 6 per cent bonds, Forty-Second Street & Grand Street Ferry Railroad Company; $50,000 first mortgage 6 per cent bonds, Twenty-Third Street Railway Company; $150,000 5 per cent debentures, Twenty-Third Street Railway Company.

Extensive improvements and additions have been made to the property during the year in converting horse lines to the standard electric system of underground conduit; replacing single-track road with double-track road, making important connections in existing lines by construction of new electric track and rebuilding and enlarging car houses to provide increased facilities for housing the additional equipment acquired.

The 145th Street line of the Ft. George & Eleventh Avenue Railroad Company has been completed from Broadway to Eighth Avenue and put in full operation, connecting the East Side and West Side lines of the subway, and also connecting the Kingsbridge line by a short cut with the elevated road at 145th street in place of the longer route to 125th Street.

The rebuilding of the Grand street line from the East River to the North River has been completed and is now under electric operation, with a branch line to Brooklyn via Williamsburg Bridge. The necessary alterations to the Corlears Street and Grand Street car houses have been completed. The rebuilding of the 129th Street and Amsterdam Avenue car house No. 1 is well under way, and will be in condition this fall to accommodate about 100 more electric cars.

The old car house at Ninth Avenue and Fifty-Fourth Street, which was partially destroyed by fire, has been replaced by a modern one-story fireproof building calculated to carry three additional stories when required. The forty electric cars to replace those lost in the fire have been purchased and received.

The car house at Forty-Second Street and Twelfth Avenue, which was entirely destroyed by fire early in the spring, is being replaced by a one-story building, with a capacity for sixty-five electric cars. The new cars to replace those lost and partially destroyed by the fire have been ordered for fall delivery. Thirty-two new long closed cars have been added to the equipment of the company in addition to those purchased to replace those lost by fire. Electric switches have been installed at many important points, thereby eliminating the necessity for the employment of special switch tenders.

An important connection was made across the new Bronx River Bridge at Westchester Avenue which, with a new double-track line from the Bronx River to Westchester in substitution for the old single track, creates a continuous and valuable direct line from 129th Street and Third Avenue to the center of Westchester.

The White Plains road from Morris Park Avenue to Olin Avenue has been converted from single track to double track, making a third continuous double-track road from Manhattan to Mt. Vernon. On 161st Street an additional track has been laid from Mott Avenue to Morris Avenue with the view of extending the double track to Third Avenue. On First Street,

Mt. Vernon, a double-track extension has been constructed from First Avenue to Second Avenue for the purpose of contributing better terminal facilities at the New York, New Haven & Hartford Railroad Company station. The relaying of tracks on south Broadway from the south line of Yonkers to Kingsbridge, which has long been delayed and obstructed pending the completion of the sewer construction, is now under way and when completed will open up an important line connecting Yonkers with the subway at Kingsbridge.

The dangerous grade crossing with the Port Morris branch of the New York Central & Hudson River Railroad Company on Southern Boulevard near 142d Street has been eliminated by the construction of a bridge over the steam railroad tracks. The new car house at Yonkers has been completed and contributes the much desired improvement in the facilities for the economic handling of the cars at that point.

The equipment of the company during the year was increased by the purchase of 25 long open and 25 semi-convertible cars, which cars are now in operation. In addition, 25 large closed cars are now being built for delivery early in the fall.

Applications have been made and are now pending for about fifteen miles of double-track extensions in the Bronx and its outlying district, which extensions, if granted, will develop new territory and meet the local demand for additional transportation facilities.

The litigation which is now in progress to support the contention of the company that the assessments levied by the Board of Tax Commissioners are excessive, has not proceeded far enough to permit of a definite calculation as to the amount of the reduction which may be obtained in these assessments. It is expected, however, that a substantial reduction will be realized. When the amount of the special franchise taxes has been finally ascertained there will be a corresponding increase in the charges to income for the year and a proportionate decrease in the surplus available for interest and other fixed charges.

Several pieces of real estate not now needed in the business of the company have been disposed of at good prices and the proceeds, $516,000, deposited with the trustees under various mortgages subject to such investment as the trustees may approve.

CLEVELAND TRACTION SITUATION

The Cleveland Electric has submitted an amended proposition, which gives several concessions over the original ordinance presented several weeks ago. It provides for more liberal paving concessions, gives the city limited power in regulating transfer privileges and provides that at the expiration of the grants the city may take over the property without having to pay for the franchise value. This is announced as the best proposition that the company will make.

The Forest City Railway Company has submitted a new general proposition covering all grants heretofore made and asking for franchises covering all the lines now operated by the Cleveland Electric, which expire between 1907 and 1910. These include the Woodland Avenue and Kinsman line, Detroit Avenue, Franklin Avenue, Scovil Avenue, West Twenty-Fifth Street, Superior Avenue, Payne Avenue, 105th Street, St. Clair Street and on Ninth Street from St. Clair Street to Prospect Street. The proposition proposes to settle the controcersy over free territory by making everything free territory included within the circle of 2 miles from the Public Square. A new feature is contained in the clause giving the city the right to reduce fares below 3 cents at any time that it is shown that the company is earning more than 6 per cent on the amount actually invested. Double transfers are offered on cross-town lines and the city is given the power to regulate the transfer system, establishing transfer points, control and regulate the car service, and determine what frequency must be run on any line.

A new ordinance has been introduced by one of the city councilmen calling for 2½-cent fare, twelve tickets for 25 cents with no transfers and revokable franchises. The councilman hopes to induce one of the contending companies to take up this proposal.

The Common Pleas Court has refused to grant a permanent injunction to restrain the city from allowing the Forest City Company to cut a right of way through Franklin Circle, a public park, on the West Side, and within a few minutes after the decision was made the Forest City Company had a large force of men laying the track through the park and cutting the Cleveland Electric's Franklin Avenue line. This was done without notice and the people on that district were greatly inconvenienced. This action completes the missing link in the low-fare company's Fulton Road line and now only the contest over the free territory on Detroit Street prevents it from operating cars to the center of the city. By virtue of a permit issued by the Board of Public Service, no franchise having yet been secured, the Forest City Railway Company is laying tracks on Bridge Avenue for another line through the west side of the city. An injunction suit has been brought by property owners.

As stated recently, in the Street Railway Journal, the Cleveland Electric Railway made a demand on the city solicitor to bring action to nullify the franchise of the Forest City Railway Company on the ground that the Mayor of the city is financially interested in furthering the street railway enterprise. The company has now decided to bring another suit on its own account covering the same contention. This suit will involve an interesting point in law, for while admitting that he has lent his credit to the Forest City Company, Mayor Johnson denies that he is financially interested in the project.

The Cleveland Electric has started a new line of battle by contesting the rights of the Forest City to use the free territory tracks on a number of streets which the low-fare company proposes to use. The action is based upon a law which makes compulsory common use of track only when the new company has trackage equal to one-eighth of that of the old company in operation on the street. The Forest City Company has no tracks on several of the streets in question and it has no line in operation at the present time.

The City Council has adopted a resolution requesting the board of elections to place before the people at the November election the propositions of the Cleveland Electric Railway Company and the Forest City Railway Company for franchises for street railways on the streets of the city. It will be remembered that the proposition of the Cleveland Electric Railway Company provides for a twenty-year grant at seven tickets for 25 cents and universal transfers on all its lines. The Forest City Company offers straight 3-cent fare and franchises revokable at any time with ultimate municipal ownership. The arrangement provides that the two companies shall share the extra expense of the election and that each company shall have a representative in every voting booth. The bringing of the matter to the vote of the public now depends upon the decision of the Secretary of State as to whether the question can legally be submitted in this manner.

The Cleveland Electric Railway Company has filed in the common pleas court its much talked about blanket injunction case asking that the Forest City Railway Company and the city authorities be restrained from in any way interfering with the property of the Cleveland Electric, and asking that all franchises granted to the low-fare company be declared void on the grounds that the Mayor of the city procured the incorporation and organization of the Forest City Company, and that he was, and is still, financially interested in the company. It is alleged that the purchases of cars and electrical equipment were made through the personal responsibility and guarantee of Mayor Johnson, and that the Mayor guaranteed and assumed the responsibility for payment to property owners of the cost of paving in consideration for the granting of consents to the new company.

At the Council meeting last week the Cleveland Traction Company, which is projected by Frank DeHass Robinson, an old street railway man, asked that a new street railway route be established in the form of a loop in the downtown district.

The Forest City Railway Company has a large force at work on Bridge Avenue, between Fulton Road and West Twenty-Fifth Street, and it is expected that this route will be used to reach West Twenty-Fifth Street free territory in case that the Cleveland Electric secures an injunction against the use of the alleged free territory stretch on Detroit Avenue. The Forest City Company is leaving no stone unturned to have its first line in operation to the Public Square before the referendum vote can be placed before the people at the November election.

The Cleveland Tramways Company has been incorporated with a capitalization of $50,000 by C. E. Sanders, H. J. Crawford, C. L. Brooks, R. F. Dennison and W. D. Whiting. It is supposed that the new company was formed for the purpose of bidding on the twelve East Side routes for which the Forest City Company has made application for grants. If the new company put in a lower bid than that of the Forest City Company, it would have to be accepted.

IMPORTANT INTERURBAN HEARING IN MASSACHUSETTS POSTPONED

The hearing announced by the Massachusetts Railroad Commissioners for Tuesday, Oct. 16, on a petition by the Boston, Lowell & Lawrence Electric Railroad, for an electric railroad over private land was postponed so as to permit the Commissioners to go over the route by automobile. This they will do Wednesday, Oct. 24. No date has been set for the postponed hearing, but one will probably be decided upon for early in November. Ex-Assistant Attorney-General F. H. Nast appeared for the petitioning company. In opposition were registered W. H. Coolidge for the Boston & Maine, Bentley W. Warren for the Boston & Northern, and A. D. Claflin for the Lexington & Boston.

The petition asks that the Railroad Commissioners certify that public exigency requires the building and operation of the road, and is the first petition of the kind to come before the Commissioners. All other requests for approval have come up under the street railway law, which covered practically all electric propositions before last winter's new law was passed, making a new class of the so-called interurban propositions (largely over private right of way) with the official designation "electric railroad." A hearing on a similar petition for the proposed Boston & Eastern Electric Railroad, projected from Boston through Everett, Chelsea, Revere, Saugus, Lynn and Salem to Danvers and Beverly, has been fixed for Nov. 21, also before the Railroad Commissioners.

Special interest attaches to these first hearings on account of speculation as to how the Railroad Commissioners will deal with the question of public exigency. Under the law, they are to approve the plans only in case they are satisfied that public exigency and convenience require the road. This would be a comparatively simple problem if Massachusetts were made up of territory sparsely built upon and devoid of existing railroad and railway lines. It has been a simple problem for the most part in dealing with street railway propositions, for the reason that most of these have been projected only in territory where their probable effect could hardly be anything else than beneficial. The problem in dealing with these roads has been rather to make sure that the roads themselves were bona fide and workable propositions, rather than to settle a doubt as to their advantage to the public in the event of their being actually built and operated.

But with these electric railroads the whole matter is different. Each of the electric railroads which have so far been proposed—and about every other such line that might be suggested as a workable proposition—marks a nearly straight course between two or more cities, under conditions that will admit of high speed with comparatively little danger, and, therefore, that give promise of noteworthy advantage to the traveling public; but each of these lines, on the other hand, will cut a ruthless swath through territory already covered by a more or less closely drawn network of existing street railways, all in operation and many of them giving through service as efficient as their necessarily indirect lines will allow. In many cases the introduction of a through line would reduce the business of existing companies to mere local or feeder service, with effects as detrimental to the territory as a whole as the introduction of the fast through line would be advantageous.

Some such situation as this has been foreshadowed in the experience of Massachusetts with the only true interurban road that has so far been built—the Boston & Worcester. When that road was put through, the Newton system of railways had just been placed under one management, and a through service was being developed between Framingham and Boston. The opening of the Worcester line, with its high speed and heavy cars, seriously affected the through business of the older network of lines, and left the system unalterably local in its scope and efficiency.

PRESIDENT MITTEN REPLIES TO MAYOR DUNNE REGARDING MEANS TO PREVENT ACCIDENTS

T. E. Mitten, president of the Chicago City Railway, has made reply in a rather lengthy letter to Mayor Dunne's recent communication regarding the adoption of measures to prevent accidents on cars. President Mitten regards the use of the Minneapolis type of gate as impracticable in Chicago as long as the present terminals are retained. He states that when the Indiana Avenue type of car was being designed he investigated the question of gates on cars, and a new car of the Twin City Rapid Transit Company, fitted with gates, was shipped to Chicago in order that the merits of the gates might be carefully considered. It was finally concluded that the use of the gates was not practicable until the downtown terminals were straightened out. But, in view of the possibility of using them at some future time, the Indiana Avenue cars were so designed as to permit the installation of gates.

In order to investigate the "pay-as-you-enter system" which is being used successfully in Montreal, President Mitten sent an expert on traffic to that city. The report of the expert, who remained in Montreal about a month, was so favorable that President Mitten later visited the city himself and was both surprised and pleased with the manner in which loading and unloading of passengers was accomplished. He intends to consider further the practicability of adopting the scheme for use in Chicago.

Mr. Mitten urges the enforcement of the so-called "flipping" ordinance as a means of preventing accidents. The railway company, he says, is powerless without the assistance of the police department to prevent accidents occurring through the "flipping" of cars.

JOHN I. BEGGS ON THE REGULATION OF PUBLIC SERVICE CORPORATIONS

At the meeting of the Westminster Men's Club, of Milwaukee, held Thursday, Oct. 11, the representatives of the Milwaukee Electric Railway & Light Company, Wisconsin Telephone Company, and Milwaukee Gas Light Company, the three largest public service corporations in the city of Milwaukee, delivered speeches favoring intelligent and honest regulation of corporate interests. As president of the Milwaukee Electric Railway & Light Company, John I. Beggs made a strong argument for the substitution of a State commission of three men removed from the influences of municipal politics in regulating public service corporations in preference to the restrictions placed on a company by a common council.

"I invite and always advocated proper, reasonable, and intelligent regulation of public service corporations, for in my judgment it affords a protection against the confiscator," Mr. Beggs is quoted as saying. "Corporations are not afraid of regulations removed from the caprices and whims of petty politicians.

"I do not think that any of the large public service corporations are afraid of honest regulation. What we are most afraid of is that the present frenzied public opinion will bring about a condition of affairs in which the corporations will receive but little consideration. We are afraid of the regulation of the demagogues of a common council who have developed a hatred toward all corporations and have gone forth as the 'saviors of the dear people.'

"Securities of public service corporations are quoted at higher figures in the State of Massachusetts than in any other State in the Union. Why? For the simple reason that there we find sane and honest regulation. No road can enter there that would make competition ruinous. No additional capital can be agreed upon without a substantial reason for issuing the stock and stating to the commission the purposes to which the additional capital is to be devoted.

"Another example is the State of Missouri. Several years ago a yellow press in the city of St. Louis started an agitation in which they maintained that the assessed valuation of the street railway properties in that city should be increased to $50,000,000. The officials of the company argued that the valuation should not exceed $17,000,000. On the State Tax Commission at that time was Governor Folk, who has acquired a national reputation, and Attorney General Hadley, who has made the Standard Oil people come to time. After conducting an investigation the assessed valuation of the properties was increased but a few hundred thousand dollars.

"This illustrates the benefit of sane regulation. Gentlemen, I tell you that the public service corporations of the country are having difficulty in borrowing money because of the frenzied public opinion of the present time."

REPORT OF THE NEW SOUTH WALES GOVERNMENT TRAMWAYS

The report of the New South Wales Government Tramways for the quarter ending June 30, 1906, is as follows: Miles in operation 126, increase ¼; revenue £223,864, increase £17,228; expenditure £162,755, decrease £8,782; car miles 4,118,903, increase 60,331; earnings per car-mile 13d., increase ¾d.; expenses per car-mile 9½d., decrease ¾d.; number of passengers carried 37,981,129, increase 2,746,997.

EARNINGS IN ST. LOUIS

The report of the auditor of the United Railways Company, issued Sept. 15, shows that the gross earnings of the company increased $466,290, the net earnings $353,788, and the net income $361,431, between Jan. 1 and Aug. 31, 1906, over the earnings and income of the corresponding period of 1905. The net income of August, 1906, shows an increase of $254 over that of August, 1905.

The report of the eight months between Jan. 1 and Aug. 31 is: Gross earnings and other income, $5,991,049 in 1906, as compared to $5,524,759 in 1905, an increase of $466,290; expenses, taxes and depreciation, $3,711,270 in 1906, as compared to $3,598,768 in 1905, an increase of $112,502; net earnings, $2,279,779 in 1906, as compared to $1,925,991 in 1905, an increase of $753,788; charges, $1,585,374 in 1906, as compared to $1,593,017 in 1905, a decrease of $7,643, and net income, $694,405 in 1906, as compared to $332,974 in 1905, an increase of $361,431.

The report for August is: Gross earnings and other income, $796,561 in 1906, as compared to $751,810 in 1905, an increase of $44,751; expenses, taxes and depreciation, $493,226 in 1906, as compared to $447,915 in 1905, an increase of $45,311; net earnings, $303,335 in 1906, as compared to $303,895 in 1905, a decrease of $560; charges, $198,026 in 1906, as compared to $198,840 in 1905, a decrease of $814, and net income, $105,309 in 1906, as compared to $105,055 in 1905, an increase of $254.

WILL CHECK BAGGAGE FREE

Free checking of baggage promises to become practically universal on the interurban lines of Ohio and Indiana. This is largely due to the efforts of the Central Electric Railway Association to secure a uniformity of practice on this important subject. The 2-cent fare law in Ohio, applicable to the steam roads, which has provided stronger competition for the electrics on the long-distance business, also had some bearing on the subject. The announcement has been made that in the future all the Schoepf syndicate properties in Ohio and Indiana will check 150 lbs. of baggage free. The Dayton & Troy, Western Ohio and Toledo Urban & Interurban lines operating the Dayton-Toledo limited service will also shortly make a similar announcement. The roads across Northern Ohio in the Electric Package Company alliance have long checked baggage free, so that this leaves only two or three lines in Ohio with the lines of the Detroit United system north of Toledo, which still make a charge for handling baggage. The fact that some roads have charged for the checking of baggage while others have not has been a decided handicap to long-distance business and an annoyance to the roads which did not favor the charge. This recent change will do much towards inducing all the lines to cater to the long-distance inter-line business.

HAMILTON-HOLZWARTH TURBINES TO BE MADE BY FELTEN-GUILLEAUME, LAHMEYER WORKS

The Hooven, Owens, Rentschler Company, of Hamilton, Ohio, has licensed the Felten-Guilleaume, Lahmeyer Werke, Frankfort-Main, Germany, to build the Hamilton-Holzwarth turbine throughout Germany. The Felten-Guilleaume, Lahmeyer Werke is one of the largest electrical concerns in Germany, with a capital of $20,000,000, and occupies the same position abroad as the General Electric and Westinghouse Companies do in America. The works manufacture both water and steam turbines, wire cables, generators, motors and all classes of electrical machinery, having recently bought the control of the Escher, Wyss Company, Zurich, Switzerland, thus controlling the Zoelly steam turbine syndicate of Germany. The Felten-Guilleaume, Lahmeyer Werke have taken up the manufacture of the Hamilton-Holzwarth turbine after a very careful investigation of the different steam turbines and after a series of most careful tests on this particular type of machine which were made at the University of Darmstadt. A result of the tests referred to above will be ready for publication in a few weeks. The Hooven, Owens, Rentschler Company has a duplicate of this machine at its works, which has also been tested and is ready for immediate shipment. This turbine is of 500-kw capacity, three-phase, 60-cycle, 2300-volt, adapted, for 1800 r. p. m.

IMPORTANT BRAKE CONTRACT

The National Brake Company, of Buffalo, N. Y., through its president, G. S. Ackley, has closed a contract with the St. Louis Car Company whereby the latter adopts the Peacock brake on all cars where gear brakes are used. The car company ceases the manufacture and sale of all gear power brakes except the Peacock. The control runs to the end of the National patent, about fourteen years, and carries a large initial order for brakes to be installed on cars now building.

NEW YORK TRANSIT COMMISSION APPROVES ROUTES FOR BROOKLYN, RICHMOND AND MANHATTAN

The Rapid Transit Commission of New York has approved the plan outlined by Borough President Coler, of Brooklyn, for a system of rapid transit subways for the boroughs of Richmond, Brooklyn and Manhattan which was approved by the Board of Estimate and Apportionment some months ago. A communication signed by Alexander E. Orr, president of the Rapid Transit Commission, has been received by the Board of Estimate. In his letter Mr. Orr agrees with all of President Coler's plan, except as regards the Broadway spur, which, Mr. Orr says, would overload the system. The line proposed would begin at Pelham Bay Park, in the Borough of the Bronx, following Westchester Avenue to the Southern Boulevard as an elevated road; thence as a subway west on 138th Street to a point near the intersection of Lincoln Avenue and East 138th Street; thence under the Harlem River and Third Avenue and the Bowery to the Battery. At a point near the intersection of the Bowery and Canal Streets a divergent branch is recommended to connect with the Manhattan Bridge, and then passing over the bridge and under Flatbush Avenue to Fort Hamilton. Near the intersection of 138th Street and Fourth Avenue there would be another divergent branch extending under Fortieth street, New Utrecht Avenue and other streets to a point in Eighty-Sixth Street near its intersection with Bay Thirty-Fourth Street, and from thence on an elevated road over Eighty-Sixth Street and Stillwell Avenue to Coney Island.

ANOTHER IMPORTANT HUNTINGTON IMPROVEMENT

In order to take care of its constantly increasing beach business the Los Angeles-Pacific Railway Company has planned to four-track the greater portion of its lines. From Vineyard, where the power house of the company is located, the rights of way have been secured to Venice for two additional tracks, and further rights of way on to Ocean Park and Santa Monica have been promised whenever needed. From Vineyard to Venice the distance on the Los Angeles-Pacific is 9 miles; to Ocean Park, 11 miles, and to Santa Monica, 12 miles. The Plaza Del Rey branch will not be four-tracked all the way, but will get the benefit of the double set of tracks as far as Ivy. When the four-track system has been completed, the two center lines will be used exclusively for flyers and the running time will be reduced, although flyers are now so numerous that no more could be used on the line, even with the extra tracks in commission. Under the schedule planned, there will be a flyer for the beaches every 7½ minutes from the company's station on Fourth Street. A feature of the four-track system that is in vogue only in the largest cities of the East, will be the running of trains of three or four trolley cars on excursion days. Of the 100 new cars recently ordered by the company, one-fourth of the number will be used as trailers. The new fully equipped cars will be of the four-motor, 300-hp variety, all equipped with the unit control. There will be additional local service on the slower cars, using the outside tracks, as well as the faster schedule to be adopted for the flyers. The four-track system will be in use probably within a year. The work at present is in standardizing the entire system of the Los Angeles-Pacific, and not until this is finished will the building of the additional set of tracks begin, but already preparations for them are being made by excavating, making cuts and widening banks. Work will be rushed according to the increase in business, although the need for the four-track system has long been obvious.

CHICAGO ELEVATED TRAFFIC FOR SEPTEMBER

For the month of September traffic of the South Side Elevated showed a daily average decrease of 727 passengers, or .81 per cent, compared with the corresponding month last year. The decrease was evidently due to the State Street line of the Chicago City Railway Company. Since the latter was changed from cable to electric it has shown a great increase in business, and it parallels the north and south division of the "L" road.

The Northwestern Elevated made the best record for the month with an increase of 4.30 per cent over the corresponding month last year. The Metropolitan had something of a halt. Its percentage of gain was 2.05, the smallest of the year. The figures follow:

METROPOLITAN ELEVATED

	1906	1905	Increase	Per Cent
January	129,730	116,013	13,717	11.82
February	135,570	121,177	14,393	11.90
March	138,169	124,853	13,316	10.66
April	137,477	124,946	12,481	9.98
May	136,735	125,164	11,571	9.24
June	133,974	124,569	9,415	7.55
July	123,370	113,578	9,792	8.69
August	123,512	116,395	7,117	6.11
September ..	126,975	124,427	2,548	2.05

SOUTH SIDE ELEVATED

January	92,406	84,659	7,747	9.03
February	95,077	88,173	6,904	7.83
March	95,466	91,384	4,082	4.46
April	95,756	91,901	3,855	4.19
May	97,159	89,971	7,188	7.99
June	101,770	93,941	7,829	8.33
July	92,976	85,272	7,704	9.03
August	88,539	85,288	3,251	3.81
September ..	89,749	89,022	*727	*0.81

NORTHWESTERN ELEVATED

January	81,191	73,728	7,463	10.12
February ...	83,572	78,773	4,799	6.09
March	85,154	80,500	4,654	5.78
April	84,244	79,779	4,465	4.98
May	81,748	77,863	3,885	4.98
June	80,165	75,837	4,328	5.70
July	73,308	67,488	5,820	8.62
August	73,176	68,938	4,238	6.14
September ..	77,508	74,307	3,201	4.30

* Decrease.

POWER PLANT ACCIDENT IN CONNECTICUT WITH DIRE CONSEQUENCES

An accident to the plant of the New Milford Power Company, about 11:00 o'clock Sunday morning, Oct. 7, left the two cities of New Britain and Waterbury in darkness Sunday night, and put most of the towns between the two cities in the same plight. In addition to this the trolley service in towns between Waterbury and New Britain, operated by the Connecticut Railway & Lighting Company, was demoralized, together with the line from Waterbury to Mt. Carmel. The running time between Waterbury and Mt. Carmel is about an hour and a quarter, but the first car after the accident was 4 hours on the trip. On Monday no factories in the two cities mentioned could be operated. The accident consisted in the breaking away of the bank of the canal which leads from the power company's dam at Merwinsville to the turbines at Bulls Bridge, where the power house is located. The raceway is built of earth without masonry, and a leak in a section of it which runs through a strip of marshy ground had been disregarded. One hundred feet of this embankment gave way, and the water rushed out across the land of J. S. Kinney and flowed into the Housatonic River without doing any damage except to the embankment. Within a moment from the time the embankment gave way every trolley car in Waterbury, Cheshire, Southington, Plantsville, Milldale, Plainville east of the railway crossing, and New Britain, was at a standstill just as the morning travel was at its height, and there the cars remained anywhere from 1 to 3 hours, according to circumstances until the auxiliary plants were got into commission.

MEETING OF NEW YORK RAPID TRANSIT COMMISSION

At the meeting of the Rapid Transit Commission last Thursday the extension of the subway from Kingsbridge to Van Cortlandt Park, at a cost to the city of $735,000, was authorized, and the New York & New Jersey Railroad Company was granted an extension of one year, until Jan. 1, 1908, of the time in which it is to complete its North River tunnel line for operation. President Winter, of the Brooklyn Rapid Transit, advised against a subway connection for the bridges, and favored an elevated loop, but said his company would not be willing to pay the city anything for the use of it, as it would not earn anything. Vice-President Bryan, of the Interborough, said his company would refuse to allow the city to use the existing elevated structure as part of the loop unless the construction of the third track on the East Side elevated lines were allowed.

TOLEDO & INDIANA EXTENSION

The Toledo & Indian Railway Company has finally completed arrangements for the extension of its line westward from Bryan, Ohio. The plan of building directly to Fort Wayne has been changed, and instead it is probable that the line will be built from Bryan to Waterloo, Ind., connecting at the latter point with the Toledo & Chicago Interurban Railway and operating into Fort Wayne over its tracks. It is stated also that arrangements will probably be made for the operation of through cars from Indianapolis to Toledo by extending the present Indianapolis-Fort Wayne service over the Toledo & Indiana. This would make a very direct route between these two important centers, the distance being about 235 miles. Plans for a through interurban service between Toledo and Chicago will doubtless be developed a little later over this route. The Toledo & Chicago Interurban now has a line in operation to Kendallville. What is known as the Bucklen line is in operation from South Bend to Goshen and from Goshen to Kendallville, 31 miles, another line is now building. The Chicago-South Bend line, also under construction, would complete the through line. The gap from Bryan to Waterloo is 25 miles.

ARRANGEMENTS FOR TESTS OF SAFETY DEVICES BY MASSACHUSETTS RAILROAD COMMISSIONERS

The Board of Railroad Commissioners of Massachusetts, in public session at Boston Oct. 3, received suggestions from the manufacturers of safety devices for use on street cars, in accordance with its advertised purpose to do this, and then intimated the manner in which it will proceed with the investigation called for by the Legislature. After this action it turned the inventors over to Commissioner Bishop, who made cursory examination of a number of the devices, and arranged with such inventors as desired it for a practical test on a street car which the board will soon have in operation for demonstration purposes on a part of the Newton system of railways.

Opening the hearing, Chairman Jackson said that the board was anxious to make the investigation a thorough one. He said the Commissioners had been making personal inspection of fenders and other devices for some time past, and would continue to do so after the hearings; but they would be glad of any suggestions. Arrangements have been made with the Newton Street Railway whereby a car for experimentation with fenders and other devices on a special section of track may be found at times to be specified later at the corner of Walnut Street and Commonwealth Avenue, in Newton. Street railway companies themselves will not be neglected in the search for information about the various devices under consideration, but the companies will be called into the matter through a special circular to be sent later.

To a question as to whether this car would be available for testing other kinds of devices Chairman Jackson said that the board would provide for a suitable test of all inventions that appeared to meet the requirements of the legislative resolve. The Commissioners would even examine inventions shown in other cities, if they could be seen more readily in operation at places where they are already in actual service. More than thirty fenders, three headlights, one ventilating device, five block signals, three switch devices, three fire extinguishers, and several other devices, such as trolley retrievers and special signals, have been called to the attention of the board.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED SEPT. 25, 1906

831,530. Trolley Pole Controller; James F. Boggs, Needles, Cal. App. filed Sept. 21, 1905. The trolley pole has a link connection with a horizontally positioned pneumatic cylinder. In case of too great vertical movement, air is automatically admitted to lower the pole.

831,542. Railway Rail Joint; William C. Deuberry, Greenfield, Tenn. App. filed Dec. 28, 1904. A tongue and slot connection extending from top to bottom of the rail and secured by bolts passing through the web of the slotted rail and through the tongue. The bolt holes in the tongue are elongated to allow for expansion and contraction.

831,550. Driving and Braking Apparatus; Lucius T. Gibbs, New York, N. Y. App. filed April 15, 1904. An explosive engine for driving the car is connected to a storage tank by means of a pipe in which a valve is mounted which permit gases of combustion to pass from the cylinder of the engine to the tank, but prevents gases from passing from the tank to the cylinder. The brakes are operated in the usual manner from the tank.

831,562. Insulated Track System; Andrew Morrison, Pittsburg, Pa. App. filed June 9, 1905. A railway track having metallic ties, insulating material between the rails and ties and insulating bushing for the bolts which secure the rails to the ties.

831,597. Combined Rail Gage and Brace; Lewis F. Bowman, Ankenytown, Ohio. App. filed May 3, 1906. The base of the rails is gripped by suitable clamps whereby the rails may be spread apart or pulled together by means of an adjusting head mounted between the clamps.

831,624. Electric Railroad; Jeremiah Murphy, Chicago, Ill. App. filed Feb. 9, 1906. The third rail is supported from a standard and has a U-shaped groove on its under side in which the periphery of a wheel constituting the collcetor runs.

831,660. Automatic Railroad Switch; Robert K. Floeter, Lima, Ohio. App. filed Feb. 23, 1906. A suitable shoe on the locomotive engages and depresses a bar which rocks a shaft on which is a gear segment meshing with a rack which is directly connected with the switch point.

831,672. Truck Switch-Operating Device; Louis Lovoy, Birmingham, Ala. App. filed June 14, 1906. Consists of a bar located between the rails and attached to the switch points, and adapted to slide laterally of the track, a second bar also located between the rails and operatively connected with the first bar and adapted to slide simultaneously therewith, and means carried by a truck for engaging and operating the last bar.

831,757. Track Laying Machine; Charles O. Wescott and Frank P. Roberts, Puyallup, Wash. App. filed June 26, 1906. A tie conveyer extends forward of the forward car and is supported therefrom, an inclined chute secured to the end of the tie conveyer by a strap or hinge, a pair of blocks secured to the lower sides of the conveyer and the chute and a strut between the blocks.

831,776. Rail Bond; Fred H. Daniels, Worcester, Mass. App. filed June 8, 1903. A terminal for rail bonds, consisting of a plug having a substantially flat enlarged head with a transverse slot formed edgewise therein from one side so as to divide the head into solid car and base portions, with an intervening slot between opening only at the edges of the head, and a lug on the upper side of the edge of the cap overhanging the open side of the slot.

831,777. Car Seat; George W. Dryer, New York, N. Y. App. filed Dec. 27, 1900. Details of construction of a car seat of the "walk-over" type.

831,782. Railroad Crossover; Edward J. Fogarty, South Bend, Ind. App. filed Jan. 26, 1906. Bed-pieces mounted on the ties and engaging the rails on the opposite sides thereof, paving-blocks interlocking with said bed-pieces and a bed or foundation to support said paving-blocks.

831,830. Rail Bond; John P. Clark, Ypsilanti, Mich. App. filed May 27, 1905. A rail bond having a terminal provided with a piece of wire-cloth secured to its under side by solder.

831,930. Motor or Engine; Charles C. Clark, Corning, N. Y. App. filed Sept. 13, 1905. A compressed-air driven engine in which provision is made for driving the same by electric means when the air supply is exhausted.

831,970. Pneumatic Sander; John J. Morgan, Baltimore, Md. App. filed June 19, 1906. Comprises a sand-receptacle having a plurality of sand-distributing devices sustained therein in different horizontal planes and air tubes in the receptacle also arranged in different horizontal planes.

832,058. Railroad Track Laying Apparatus; George F. H. Hicks, Chicago, Ill. App. filed April 4, 1906. Consists of a pioneer car having a track thereon for a tie-car, a boom pivoted to the pioneer car at a point above the operating position of the tie-car and having a chain-block suspended from the boom and means for connecting the chain-block with a rail whereby the rail may be disengaged from the car, suspended over its operative position on the roadbed during the laying of ties thereon, and means for quickly lowering the rail and heeling it to place on the ties.

832,092. Brake-Shoe; Frank R. Spear, Chicago, Ill. App. filed Oct. 20, 1905. A brake-shoe comprising a body and a cast malleable iron place secured to the body or adjacent to its back.

832,137. Railway Switching and Signaling Apparatus; William Macomber, Buffalo, N. Y. App. filed Feb. 20, 1905. This patent and those following to the same patentee, relate to means in a block signal system for presenting signals when switches along the track are operated. This patent pertains particularly to preventing short circuit between the connections having any effect on the signals.

832,138. Railway Switching Apparatus; William Macomber, Buffalo, N. Y. App. filed Feb. 20, 1905. Relates to modifications of the above patent.

832,139. Railway Switching Apparatus; William Macomber, Buffalo, N. Y. App. filed Feb. 20, 1905. Means whereby the switch tongue may be returned to its initial position at any time after a movement has been begun and before the switch has gone to full reverse and been locked.

832,140. Railway Switching Apparatus; William Macomber, Buffalo, N. Y. App. filed Feb. 20, 1905. Mechanism for moving and locking the rail-switch and for making and breaking the electric circuits as required by the system in connection with which it is used.

832,145. Brake-Shoe; James F. Morrison, Chicago, Ill. App. filed Jan. 8, 1906. Comprises a body and a cast malleable iron shell inclosing the body and having openings, with beveled walls therein to receive portions of the body.

832,146. Brake-Shoe; James F. Morrison, Chicago, Ill. App. filed Jan. 8, 1906. A brake-shoe comprising a body, a cast malleable iron shell inclosing the body and dove-tailed ribs on the sides of the shell, making locking engagement with the body.

832,153. Electric Signaling Apparatus; Charles J. O'Neil, Washington, D. C. App. filed Feb. 4, 1905. A metallic plate is spring against the rail and has ends curving away from the rail. The flanges of locomotive wheels presses the plate away from the rail whereby a echanical connection is made to a switch blade through a mechanism which throws the blade oppositely at successive actuations.

832,165. Railway Switch Operating and Controlling Apparatus; Wilmer W. Salmon, Buffalo, N. Y. App. filed May 17, 1906. This patent and the series following relate to the same general signal installation as covered by patent 832,137 (above referred to). This patent covers means whereby the movement of the switch rail may be reversed at any point of movement and restored to its initial position, and also by which the actuating current is automatically cut off from the motor when a complete movement has taken place.

832,166. Railway Switching and Signaling Apparatus; Wilmer Salmon and Frank L. Dodgson, Buffalo, N. Y. App. filed Jan. 6, 1906. Means for controlling an outlying switch and signal by a single circuit which accomplishes several functions.

832,174. Railway Signaling Apparatus; John D. Taylor, Buffalo, N. Y. App. filed Jan. 22, 1904. Improved mechanism and arrangement of circuits for returning the signal to normal before the controller is put at indication, and at the same time secure dynamic indication when the controller is put at indication.

832,175. Railway Switching Apparatus; John D. Taylor, Buffalo, N. Y. App. filed Feb. 2, 1906. Modifications of the preceding patent.

832,185. Right-Angle Adjustable Crossing for Electric Railways; Edward E. Gilmore, Philadelphia Pa. App. filed Sept. 27, 1905. Adjustable cross-arms and bracing members removably secured thereto, said cross-arms and bracing members being centrally pivoted so that each bracing member moves in unison with its respective cross-arm whereby it is braced in any position to which it may be adjusted.

832,186. Car Derailer; Leonard B. Gump, Toledo, Ohio. App. filed March 19, 1906. A device for replacing derailed cars con-

sisting of inclined flanged guideways adapted to be secured to the rail by a suitable clamp.

832,187. Signal; Edward A. Halbleib, Buffalo, N. Y. App. filed May 22, 1905. A semaphore having two signal arms operated by a single rod.

832,192. Railway Switching and Signaling Apparatus; Winthrop K. Howe, Buffalo, N. Y. App. filed Aug. 29, 1905. Means whereby the signal circuit or circuits are not completed until after the switch points are moved to their proper position and locked, and means for breaking the signal circuit or circuits if the switch points are either moved from their proper position or unlocked.

832,193. Railway Signaling Apparatus; Winthrop K. Howe, Buffalo, N. Y. App. filed Nov. 27, 1905. Comprises insulated rails in a block section, a releasing magnet at one end of the block, a manually-operated generator at the other end of the block and means for closing the generator in circuit with the magnet.

832,194. Railway Signaling Apparatus; Winthrop K. Howe, Buffalo, N. Y. App. filed May 17, 1906. Means for operating a home and distant signal, the one by the rotation of the motor in one direction and the other by rotation of the motor in the opposite direction, and in so doing to cushion the movement of the signals as they go to the proceed position, and also to give indication of movement of the signals to the proceed position.

832,195. Railway Signaling Apparatus; Winthrop K. Howe, Buffalo, N. Y. App. filed July 20, 1903. Relates to mechanism which will effectively operate signals of the semaphore type and which is capable of being incased in the signal post.

832,202. Safety Device for Railroads; Constantin Klinik, Tarnowitz, Germany. App. filed Feb. 6, 1906. A flexible member trails behind a train in a suitable conduit between the track rails, so that a following train will be automatically stopped when it arrives in the danger zone determined by such flexible member.

832,206. Automatic Car Fender; James A. McMillan, Santa Paula, Cal. App. filed Oct. 23, 1905. Comprises a pair of curved arms, a scoop comprising cross-rods which lie in slots in the arms, wires uniting the cross-rods, the slots having variant paths to cause the front end of the scoop to lower when the scoop is retracted, means for yieldingly holding the scoop in forward position, and a basket supported by the arms with its lower portion arranged close to the scoop.

832,243. Automatic Switch; Harvey Dennis, Seattle, Wash. App. filed Jan. 24, 1906. Details of construction.

832,297. Safety Device for Electric Signals; Fred B. Corey, Schenectady, N. Y. App. filed June 16, 1904. In order to prevent accident from failure of electric lights in signal appartus, a relay is provided which sets a train stop in case of interruption to the lighting current.

832,312. Section Insulator for Electric Railways; Edward E. Gilmore, Philadelphia, Pa. App. filed Sept. 27, 1905. Comprises an insulating body having wire-holding members at each end thereof, each of the wire-holding members provided with a sinuous groove for holding the wire and a clamping plate for pressing the wire within the groove.

832,416. Electric Railway; Leon W. Pullen, Camden, N. J. App. filed May 18, 1905. Relates to that type of railway having spaced contact plates in the roadbed which are automatically energized by magnets on the car during its passage.

832,462. Automatic Electric Brake; Augustus L. Duwelius, Cincinnati, Ohio. App. filed May 7, 1904. In conjunction with the usual hand brake the invention comprises an electro-magnetic actuator for operating the vehicle brakes, which is energized by current from an electrical generator on the vehicle, said generator under normal conditions constituting the vehicle motor, but in the breaking operation being transformed into a generator by breaking the circuit leading to the power source and concurrently establishing another circuit from the generator through the brake actuator.

832,492. Railway Crossing; Benjamin F. Martin, Dayton, Tenn. App. filed July 7, 1906. Comprises a cast metal frame formed of sections having abutting portions, rails embedded in the frame sections with their heads lying flush with the surface thereof, said frame sections being provided with grooves on the inner sides of the heads of the rails, bridging connections between the abutting portions of the frame sections to hold the same from lateral displacement, and ties connecting said portions to secure them against longitudinal displacement.

822,544. Automatic Trolley Guard; John R. French, Los Angeles, Cal. App. filed Nov. 15, 1905. The trolley pole is hinged at its upper end, and when the pole leaves the wire the hinged section moves relatively to the pole and actuates a slide valve to admit air to a retrieving cylinder.

832,548. System of Railway Signaling; Harry L. Johnson, Topeka, Kan. App. filed April 29, 1905. A spring blade is held adjacent to the track rail and in the path of the wheel flange, so as to have contact established therewith by the passage of a train.

PERSONAL MENTION

MR. CHARLES COOKE has resigned as roadmaster of the New York & Long Island Traction Company.

MR. H. HARTFORD, foreman of the Coney Island & Brooklyn Railroad Company's repair shops, where he has been employed for the past twelve years, has resigned, and has accepted a position as foreman with the Consolidated Railroad Company, of Hartford, Conn.

MR. W. E. MOORE, general superintendent of the West Penn Railways Company, has been promoted to general manager, a position which has been filled by Mr. W. S. Kuhn, of Pittsburg, in the past. Mr. Kuhn retires from active management of the road, but remains president of the company.

MR. S. W. COLEMAN has resigned as electrical engineer and master mechanic of the Petaluma & Santa Rosa Railway Company, of Petaluma, Cal., to accept the position of general manager of the Union Traction Company, of Santa Cruz, Cal. This property has been acquired by John Martin and his associates, who recently took over the lighting and gas company in the same city.

MR. J. R. HARRIGAN, who has been general manager of the Canton-Akron system, recently consolidated with the Northern Ohio Traction & Light Company, will continue with that company as manager of the lines south of Akron which heretofore have been in his charge. The directors of the Northern Ohio Traction & Light Company were greatly pleased with Mr. Harrigan's administration and decided to make no change.

MR. GRAHAM B. DENNIS, who built the first electric railway in the Northwest in Spokane in 1887, and who has since been identified with development projects, commercially and industrially, has just been elected president of the Pacific Northwest Development League, which will exploit the resources of Washington, Oregon, Idaho and Montana. The league will have a fund of $100,000 to be used in a campaign for population and commerce in the quartette of States. Mr. Dennis is a pioneer of the Northwest, coming to Spokane twenty-two years ago from Dayton, Ohio., and his identification with Spokane and its commercial interests and the development of the State of Washington are parts of their history. As chairman of the publicity committee of the Spokane Chamber of Commerce he attracted millions of Eastern capital to that part of the country, and he has been the means of interesting prominent men in the East and Middle West in electric railway construction and power plants, giving the various cities and towns in Eastern Washington a service which would do credit to much more closely populated territory.

MR. H. WALLERSTEDT, whose work as chairman of the American Street and Interurban Railway Engineering Assoeiation has made him well-known in electric railway circles, has resigned from the Interborough Rapid Transit Company, of New York, to accept a position with Ford, Bacon & Davis, of that city. Mr. Wallerstedt is a native of Sweden, where he was born in 1869. He received his early technical education in that country and in 1889 came to the United States. His first position was with the General Electric Company in its Chicago office. Later he accepted a position under Mr. W. E. Baker, when the latter was installing the electrical equipment for the Metropolitan West Side Elevated Railway, of Chicago, the pioneer road of its kind. With this company Mr. Wallerstedt stayed two and one-half years, going afterward to the Suburban Railroad, of Chicago, until it was purchased by the Yerkes syndicate. After a brief experience with Sargent & Lundy and the Illinois Steel Company he came to New York in 1899, where he entered the employ of the Manhattan Elevated Railway when that system was being electrified. With this company and its successor, the Interborough Rapid Transit Company, Mr. Wallerstedt remained to the present day as engineer of car equipment.