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NEW YORK, SATURDAY, OCTOBER 14, 1911.

CONTENTS.

The Adoption of Association Standards

The rules of procedure for the adoption of standards which were adopted by the Engineering Association at its closing session on Friday morning provide a logical and definite course to be followed in the suggestion, consideration and finally the adoption of standards and recommended practice. All will agree that sufficient safeguards should be provided against hasty adoption of carelessly prepared recommendations. At the same time, if it should be necessary or desirable for any reason to obtain prompt action on a proposed standard, the course of procedure is not too cumbersome to permit the completion of all the work which precedes the sending out of letter ballots within a period of three months prior to the annual convention. The scant attendance at the closing session on Friday morning when this subject and the report of the committee on standards were presented leads us to suggest a change in the order of the program next year so that the report of the committee on standards would be presented on the second day of the convention, when it would receive the careful consideration which it deserves. The report of this committee is perhaps the most important business which comes before the association during the convention, and it should be presented at a time of maximum attendance instead of on the last day, when only a few members, who are anxious to get away, are in the meeting room.

Proper Basis for Rates and Fares

The value of the midyear meeting of the American Electric Railway Association is emphasized in no stronger way than by the recommendation of a committee made at the Atlantic City convention that its report on rates and fares be discussed at the gathering in January. Very often it has happened that excellent suggestions well adapted to improve the status of the industry and the condition of the companies have failed to receive proper consideration because they were presented in the hurry of a convention meeting without a definite request for future action on the proposals advanced. The subject assigned to this committee is the determination of the proper basis for rates and fares, and the association cannot do better than to afford every opportunity within its power for further and definite consideration of this topic at the midyear meeting. It is one of the weaknesses of the electric railway situation that the rate of fare has been made the same in so many cities where costs of construction and operation were not alike. Uniform fares are justifiable when they are applied to like properties and like conditions of travel, but they have been extended indiscriminately and without careful investigation. The "basis for fares" should include an allowance for the

ever-increasing costs of labor and materials. These costs have been realized by practically all companies in the country, if not directly, at least indirectly. Their existence is a tangible element that has overcome in many places the effect of the greater earning capacity which is to be expected from a normal increase in density of traffic. The committee has suggested six different methods, but expresses a preference for a modified zone system. Any form of this kind of fare seems so foreign to American methods that the publication by the committee of its reasons for reaching this conclusion will be of great interest to electric railway companies at large.

ACCIDENT PREVENTION INSTRUCTION FOR EMPLOYEES

The general sentiment of this year's convention of the Claim Agents' Association was expressed in the remark made in B. F. Boynton's paper, that the principal efforts of the modern claim agent must be directed toward the prevention of accidents rather than the care of them after they have occurred. This standpoint was taken not only in Mr. Boynton's paper, entitled, "How Can the Public Be Educated in the Prevention of Accidents?" but also in the papers of Messrs. Carpenter and Whitehead, in which the question of accident prevention by employees was considered. The papers of Messrs. Walsh and Beck, however, went to the root of the problem, namely, the selection and instruction of platform men.

It is a fact that the men who are responsible for the training of new men must impart to them so much detail regarding their regular transportation duties alone that little time is left to discuss the seemingly remote matter of accidents. Probably it would be better to have this subject taken up when the student is nearing the end of his tutelage, because he is then familiar enough with the equipment to understand his responsibilities. The question remains: Who is to impart this instruction, both to the recruit and to the veteran? Some companies leave this matter to the schoolroom instructor, some to the division superintendent, some to the claim department representative, and some use the services of all three but without any definite plan of procedure.

Since the impression that any instruction makes upon a man must depend very much upon the authority of the instructor, it is desirable that the more important features of accident prevention should be presented by the division superintendent, who has full authority over the men and is thoroughly familiar with the conditions under which they work. For instance, he would not expect the men who operate cars through the slum districts to have as few accidents and to secure as many witnesses as those who operate through a better section of the community. Under his direction the representative of the claim department might very well describe the uses of and the methods of filling out the several report forms, but it is the superintendent himself who should take up the moral side, namely, the employee's responsibility for safeguarding life and property. Furthermore, only he should have the authority to point out that an unavoidable accident will not mean a black mark against the man who was concerned in it. It is well to explain this because men are tempted not to report accidents on account of this feeling. Talks on accidents should be given, say, once a month at informal smokers, at which the superintendent can discuss the accidents of the month, pointing out how some of them could have been avoided and mentioning the character of accidents which are likely to be most frequent during the coming month, such as those caused by the opening of schools, introduction of summer cars, approach of snowy weather, etc. Attendance at these meetings should be considered a part of the employee's working time and he should be paid regular platform rates accordingly. This action will go far to impress the men with the fact that the company considers these talks of great importance.

DESIGN AND MAINTENANCE OF CARHOUSES

The report of the committee on buildings and structures which was presented at the convention before the Engineering Association is of a most valuable character in view of its clear and definite conclusions on the subjects of building construction and maintenance, facilities for employees and the fire protection of buildings and yards. Under the head of "Economical Maintenance" the committee recommended that buildings should be regularly inspected, preferably at monthly intervals, and that the conditions be noted on a regular inspection form. This suggestion is an excellent one, as it will tend to fix the responsibility for the condition of buildings. Under the present form of organization in all but the largest companies this responsibility is so widely scattered among the several departments that what is everybody's business becomes nobody's business.

The recommendations on carhouse heating call for the indirect method—that is, a system where the air is blown through steam coils and throughout the building. There is little question that a blower system offers most satisfactory heating for carhouses, especially those with closed pits. In winter time it is superior to steam pipes because the pitmen are in no danger of being burned or scalded, while the pits remain free from condensation; in summer the duct layout is available for forced ventilation. Failures of the indirect system are generally due to ignorance in calculating the heating requirements, to the wrong layout of ducts and to waste of heat at open outlets where no men are working. In short, those who wish to install the indirect system must be prepared to have it designed by a specialist and watched with more than usual care.

The subject of heating is closely related to that of track doors. Steel shutters are a necessity where clearance conditions are paramount, but the labor of raising and lowering them by hand at frequent intervals practically means an open carhouse and a cold one, no matter what heating system is applied. It is therefore regrettable that the committee has not found the motor-operated shutter to be generally satisfactory. Doubtless a little wider experience with power-operated doors will find a cure for any present objections to them.

Perhaps the most striking section of the report is that relating to proper facilities for employees—not only facili-

ties for making out service reports, but also for spending idle time agreeably at the carhouse. The welfare aspect of the handling of platform men has become so important that no railway can afford to overlook these means for keeping experienced men in the service and cutting down the high cost of training new men. In the future no carhouse will be considered complete without a club room and even a cost-price restaurant. Dormitories where the men can have a bed for a low price have also been found desirable for isolated carhouses. It is not necessary or even desirable that the company should give all welfare privileges without cost. Probably the most approved practice is to charge small fees and to turn over any profits to the employees' sick benefit or entertainment funds. On the whole this part of the report is of much more importance than the discussion of carhouse design and it deserves careful attention by managers and other executive officials.

The section relative to fire protection of buildings and storage yards also contained many good points. For example, one recommendation was that there should be an ample equipment of sand pails, water pails and small extinguishers. It is usual to consider these as minor or auxiliary equipments, but they are really of great importance, as they must be depended upon to put out a fire before the sprinklers, standpipes or chemical engines can be brought into action. Another good recommendation was that the layout of all fire-protection apparatus should be given on a general plan which would be posted throughout the property to guide every employee whether or not he was a member of the fire-fighting corps.

THE AMERICAN CONVENTION AND PUBLICITY

The keynote of the convention of the American Association this week was publicity; publicity not only of accounts, but of all the serious economic problems which are now confronting electric railway companies. The financial and economic questions are in many ways related, and the lack of published data in regard to the accounts has undoubtedly been instrumental in perpetuating an ignorance on the part of the public of the fundamental requirements of successful and profitable electric railway operation. Indeed, a misapprehension of the real condition of affairs is to be found, not only among the general public, which gives little thought to such matters, but even among financiers who are supposed to be familiar with the corporate affairs of all large undertakings. It may be difficult to change this situation in a short time, but there appear to be no fundamental obstacles if the railway companies consider that the effort is worth while.

To our minds, two steps are necessary. The first is *real* publicity of the accounts. This is being required in some States, but few companies publish more statistics of their service than are actually demanded by the authorities. The practice followed by many of the large steam railroad companies of issuing annual reports which give the operating expenses and unit costs of the companies in great detail has been honored in the electric railway industry more in the breach than in the observance. Yet without these figures it is impossible for the student of financial values to determine even approximately the extent, if any, to which charges properly belonging to operation are being placed in the construction account. The latter, like charity, often covers a multitude of sins.

We admit that such publicity may be temporarily disadvantageous to some companies, or, rather, that it may be disadvantageous to the financial interests in the control of such companies. We believe that where the policy of silence is followed it is dictated in nine-tenths, and probably in 99 per cent, of the cases by the owners rather than by the managers. The dividend must be maintained or at least a surplus over operating expenses must be shown so as to insure the best market price for the securities. Hence too close scrutiny of the operating expenses and unit costs is not desired. So long as the methods of keeping the accounts of a railway company are made dependent upon the stock ticker, just so long will it be impossible for anyone to learn the whole story about a railway property. This fact should be clearly understood.

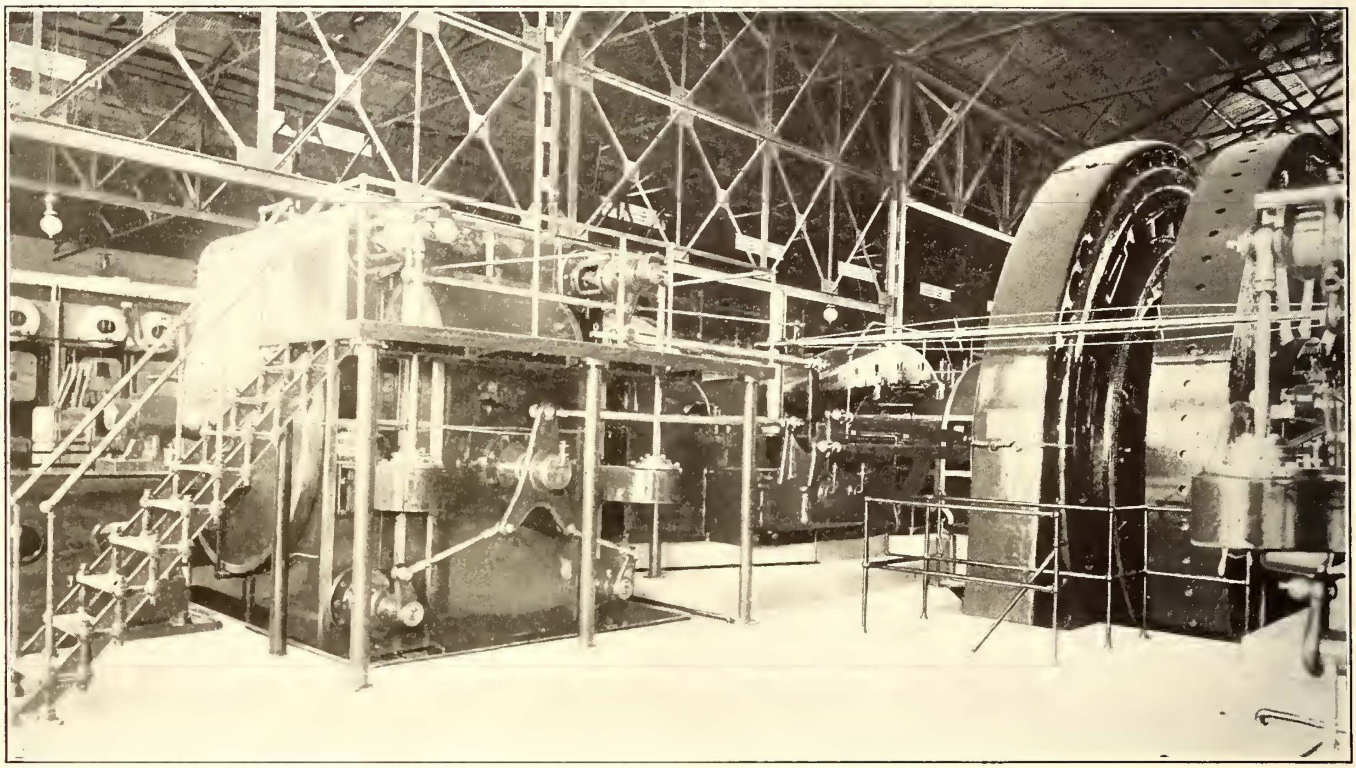
But a policy of complete publicity of accounts alone will not fulfil the requirements, according to the sentiments expressed by many of the delegates at Atlantic City. There is almost as much ignorance in the public mind of the economic conditions surrounding a railway company as there is about its finances. In spite of the widespread talk about the high cost of living, few people realize that during the past ten or twenty years there has been a great reduction in the cost of street railway transportation and that the nickel purchases far more in the way of speed, comfort and safety to-day than ever before. The ordinary householder may grumble at his increased cost of food, clothing and other necessities, but he accepts the advance in prices because he realizes that there has been a world-wide increase in the cost of production. He has even paid with surprising equanimity higher steam railroad fares in different parts of the country because he knows that the steam railroads pay more to their labor and more than they did several years ago for the rails, cars and other materials which they buy. But he argues that with the street railways the conditions are different. Tremendous economies must have followed the operation of cars with electricity. If this were not so, why did the companies make the change? Moreover, some people in some cities have made a lot of money out of electric roads, although whether this money was made through manipulation is not clear in the average lay mind. At any rate, the politicians have said that all street railway passengers should have free transfers, and if a railway company can carry a man on one route 5 miles for 5 cents what good reason can be advanced why the same company or two connecting companies should not carry a passenger the same distance on several routes for the same price?

We believe that one means by which this misapprehension of the real condition of the affairs of electric railway companies will be removed will be through public service commissions, before which at least evidence of the real facts may be laid. But public service commissions alone cannot do all the work. They should be supported by a public sentiment that railway companies require some relief. And there is no one who is enough interested in the matter to conduct this education except the companies and the financial interests behind them.

Power Plant Extension on Key Route System

The New Equipment for This Large Direct-Current Generating Plant Includes a 2700-kw Set Made Up of a Corliss Type Engine and an Interpole Generator

The San Francisco, Oakland & San José Consolidated Railway, generally known as the "Key Route" in California transportation circles, has recently completed a 2700-kw addition to its generating station on San Francisco Bay, including new boilers, feed pumps, condenser, engine and generator unit and a steel stack 9 ft. in diameter by 120 ft. high. The company operates multiple-unit trains in one of the most dense traffic areas in the West, about 575 daily train movements being made in and out of its well-known pier terminal at Oakland in connection with the handling of suburban travel between San Francisco and the cities and towns lying on the easterly side of the bay. The above terminal, where transfer is made between the company's electric trains and ferryboats, is located at the end of a pier 17,000 ft. long. Double-track service, protected by automatic block signals with emergency air-brake trips, is regularly maintained. The power plant is located near the shore end of the pier, practically in the center of electrical distribution of the system, which includes local street railway service in the municipalities of Oakland, Berkeley and Piedmont under separate corporate organization and supplied in part with power from adjacent hydroelectric systems.



Key Route Power Plant—View of Engine Room

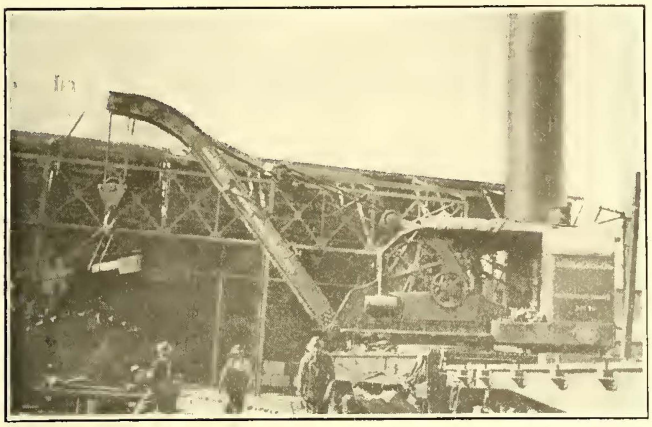
LOCATION OF POWER STATION

The power plant, known as the Yerba Buena station, contains five direct-connected, engine-driven, 575-volt, direct-current railway generators having an aggregate rating of 7350 kw; eight water-tube boilers rated at 250 hp each, and four boilers rated at 500 hp each. Prior to the installation of the present 2700-kw unit the plant contained one 800-kw, one 650-kw and two 1600-kw units, these being operated by the 250-hp boilers above mentioned. The growth of the company's business consequent upon striking gains in population in Oakland, Berkeley and Piedmont and from vigorous publicity work on behalf of the Key Route necessitated a substantial increase in power station capacity and the decision to install an engine-driven equipment was the natural result of the conditions of electrical distribution under which the station operates. The general layout of the system supplied from the Yerba Buena station is fan-shaped, with the handle corresponding to the pier, and the maximum distance of distribution from the station in any direction is about 3 miles. The traffic is of the short-haul type and the absence of any need of high-tension transmission at once precluded the installation of turbine-driven equipment.

RECIPROCATING ENGINE AND ITS FOUNDATIONS

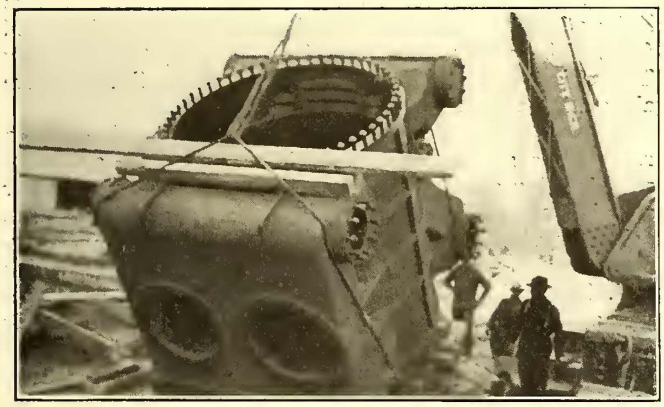
The new unit is a General Electric interpole generator operated at 75 r.p.m. by a 42-in. x 86-in. x 60-in. horizontal cross-compound Hamilton-Corliss condensing engine having a 100-ton flywheel and equipped with a shaft weighing 75 tons. This engine is the largest of the Corliss type in service on the Pacific Coast. It is installed upon new concrete foundations placed on an excavated area at the east of the original engine room, the work of excavation being handled as shown in the accompanying illustrations at an unusually low cost. Excavation for the foundations, which are carried to a depth of about 13 ft., was effected by hand, the spoil being shoveled into skips of 2 cu. yd. capacity each and hoisted from the excavation and discharged upon flat cars by a locomotive steam crane owned by the company, the capacity of the crane being 40 tons. A track was run by the company into the engine room and the cars loaded with excavation hauled in and out by a motor car operated from the overhead trolley. The loaded cars were hauled to an embankment on the station property and discharged into a fill by the use of hydraulic giants having 2-in. nozzles and supplied with water under a pressure of 175 lb. per square inch. With the exception of the initial excavation no handling of the material was required on a

manual basis. The water was supplied to the nozzles by a steam pump and after the earth was discharged upon the filled area it was spread by an ordinary hose. Salt water was used in both instances.



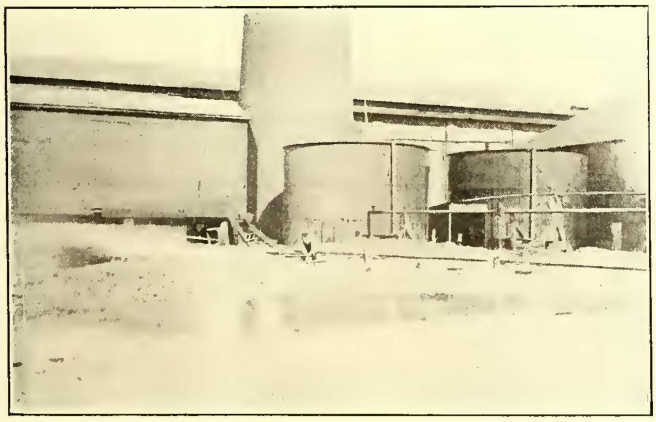
Key Route Power Plant—Handling Flywheel Section with Locomotive Crane

The locomotive crane was also used in handling all machine parts in erection. The heavier pieces were necessarily handled half at a time, as in the case of the shaft,



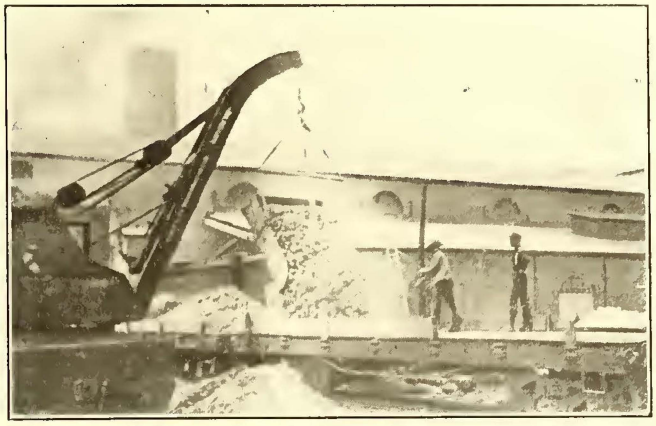
Key Route Power Plant—Handling One of the Cylinders by Crane

but all sectional parts were placed in position by the crane with minimum cost because it was possible for the crane to enter the station on the side track and deposit the ma-



Key Route Power Plant—Spreading Earth in Fill by Hydraulic Jets

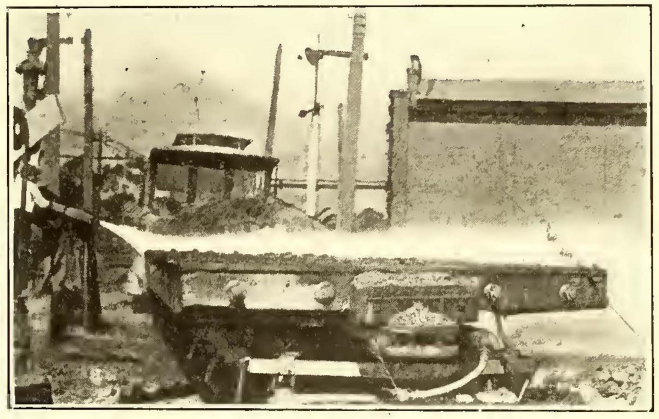
chinery at the desired point without the usual elaborate process of building up timber cribbing and utilizing jacks, skids and pulleys at practically every stage of the work. Pile foundations were required beneath the concrete upon which the frame of the unit rests. All the steel work used in the roof truss of the power house extension was fabricated by the company on the ground, this being placed in position last in the work of construction, the boilers being erected after the engine and generator had been placed.



Key Route Power Plant—Dumping Excavated Earth on Flat Car

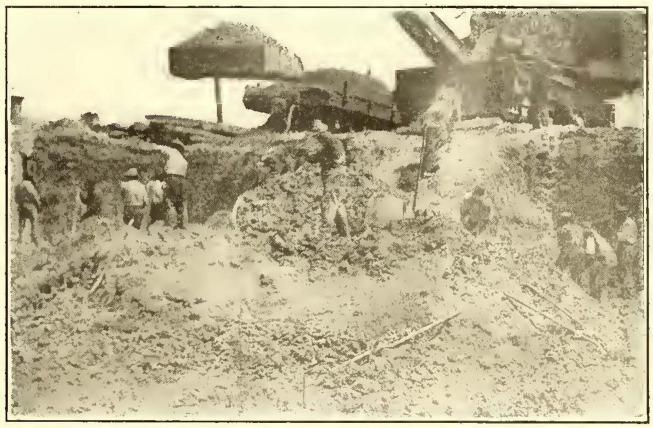
PIPING AND AUXILIARIES

The extension of the plant is arranged to operate in multiple with the older portion of the station, both in the



Key Route Power Plant—Clearing Off Car by Hydraulic Jets

boiler and steam sections. Fuel oil is burned under all boilers in the station, the piping being arranged so that any burner can be blown out by live steam by the adjustment



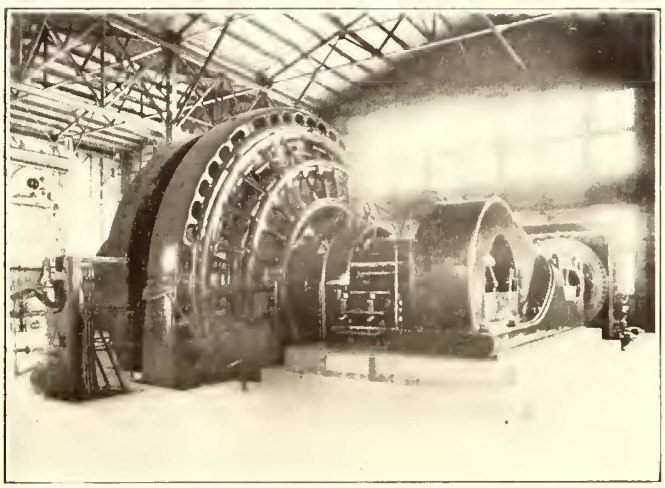
Key Route Power Plant—Removing Excavated Earth from Foundation Site.

of the proper valves. Salt water is used for the operation of condenser equipment throughout the plant, the new unit exhausting into a Wheeler surface condenser provided with an Edwards air pump of the triplex type, with 16-in. x 10-in. cylinders. The circulating water is drawn from a cool-

ing pond connected with the bay and returned to the pond after passing through the condenser. The circulating pump, a 16-in. centrifugal outfit, is direct-driven by an 80-hp, 575-volt, direct-current motor coupled to its horizontal shaft and the same motor also drives the triplex air pump through reduction gearing. The air pump exhausts into a pipe leading to a hot well constructed of redwood, with excelsior filling to separate the oil from the condensed steam. The hot well is 25 ft. long, 6 ft. 3 in. high and 8 ft. 8 in. wide, and contains seven removable compartments spaced 3 ft. apart on centers. Each compartment barrier is provided with 152 holes, 1 in. in diameter, bored in eight rows from the top of the compartment downward, to handle the flowage through the apparatus. A 9-in. intake and 7-in. discharge are provided at the opposite ends of the hot well and the principal timbers used in its construction are 3-in. x 12-in. redwood sticks. The condenser is connected with the exhaust lines of the older engine units through a 30-in. pipe and an atmospheric exhaust is also provided through a 30-in. relief valve and riser leading to the outside of the station in the usual manner.

BOILERS

From each of the new boilers a 10-in. riser delivers steam to a main 16 in. in diameter connecting with the new engine



Key Route Power Plant—2700-kw Unit Consisting of Corliss Engine Direct Connected to Interpole Generator

unit through a separator, the main also having a 16-in. connection with the steam header of the older boiler plant, so that the boilers are all operated in multiple. A 4-in. steam connection leads to the feed pumps for the new installation, these being 12-in. x 7¼-in. x 12-in. Wheeler duplex units, connected by a suction line with the hot well. The boilers are operated at 200 lb. pressure and are provided with a complete 6-in. feed-water loop, insuring continuous service at all times. The generator operates in parallel with the older units on the station busbars, the fluctuations of the load being handled by a 1500-amp hour storage battery and booster installation which have for some time been associated with the older equipment. J. Q. Brown is chief engineer of the Key Route electrical and mechanical department.

John A. Beeler, vice-president and general manager of the Denver (Col.) City Tramway Company, who was in Europe this summer, contributed to the September issue of *Tramway Bulletin*, published in the interest of the street railway men of Denver, an illustrated article entitled "A Few Notes on Europe." In previous issues of this magazine Mr. Beeler gave his opinions of electric railway methods abroad. This bulletin is published under the auspices of the Denver City Tramways and is sent to all the men employed on the system.

MEETING OF THE RAILWAY SIGNAL ASSOCIATION

The sixteenth annual convention of the Railway Signal Association was held at the Hotel Antlers, Colorado Springs, Col., on Oct. 10. The convention was opened by an address of welcome by the Mayor of the city. President C. E. Denney, signal engineer of the Lake Shore & Michigan Southern Railway, was in the chair.

At the morning session reports of the committees on mechanical and power interlocking were received. Lunch was served to the members and guests by the Railway Appliance Association.

The report of the committee on automatic block signals for steam roads was then considered. Following this the report of the committee on electric signals for electric railways was presented. This report comprised detailed descriptions, fully illustrated, of the systems of signaling in service on the various roads. The first described was that of the Pennsylvania Railroad at the Washington terminal, with special reference to the power transmission system, which consists in part of two-conductor No. 6 B. & S. gage flexible cable laid underground in wooden trunking and surrounded by pitch. The alternating-current signals between "A. T." Junction and Holliday, on the Atchison, Topeka & Santa Fé Railway, and a similar system on the Cumberland Valley Railroad were described next. Under interurban railways the signals on the Auburn & Northern Electric Railroad, the Syracuse, Lake Shore & Northern Railroad and the Illinois Traction System were described fully. There was also a section devoted to the Hoosac Tunnel installation on the Boston & Maine Railroad, where alternating-current propulsion is used.

Following the descriptions of existing installations was a report of a sub-committee, consisting chiefly of an elaborate drawing showing the committee's recommendation for a typical alternating-current automatic block signal system, using three-position upper right-hand quadrant signals, normal clear. Next was presented an elaborate description with illustrations of three-position alternating-current relays as made by the various signal companies, giving their application to signaling in the wireless control of the distant indication. With this was a treatise on frequency relays, which are used to respond to current of a certain frequency only. The report was concluded with specifications for apparatus and material to be used in an alternating-current signal installation.

There was very little discussion, as the subject matter of the report dealt rather with the history of the art than with recommendations. It was the consensus of opinion that the committee had made a very valuable contribution to the art and literature of the subject and there were several expressions of approval of the report.

The report was accepted and the specifications will be placed before the members for a letter ballot.

The program for the day was concluded by a consideration of the reports of the committees on the manual and the promotion of signaling education. On following days reports were received from the committees on signaling practice and standards, automatic stops and cab signals, subjects and definitions, storage battery, recording signal failures, wires and cables and contracts reported.

Officers for the coming year were elected as follows: C. C. Anthony, Pennsylvania Railroad, president; B. H. Mann, Missouri Pacific Railway, and F. P. Patenall, Baltimore & Ohio Railroad, vice-presidents; C. C. Rosenberg, secretary-treasurer.

The record of passenger-train performances on the steam railroads of the State of New York for the month of August, just issued, shows that during the month the number of trains run was 70,351. Of the number of trains run 81 per cent were on time at the division terminal.

Engineering Association Papers

Abstracts of the Three Committee Reports Presented at the Closing Session of the Engineering Association on Friday Morning

At the closing session of the Engineering Association on Friday morning reports of the following committees were presented and discussed:

Committee on rules of procedure of the committee on standards: Paul Winsor, chairman; C. B. Voynow, Rodney Hitt.

Committee on standards: Paul Winsor, chairman; H. H. Adams, M. V. Ayres, M. H. Bronsdon, A. F. Hovey, E. R. Hill. E. B. Katté, J. M. Larned, F. G. Simmons, L. P. Crecelius, Charles Hewitt, J. H. Hanna, Martin Schreiber.

Committee on equipment: M. V. Ayres, chairman; H. A. Benedict, vice-chairman; A. T. Clark, F. R. Phillips, H. L. Patterson, Homer MacNutt, F. R. Grimshaw, W. Thorn, J. M. Bosenbury.

Abstracts of these reports follow:

REPORT OF THE COMMITTEE ON RULES OF PROCEDURE OF THE COMMITTEE ON STANDARDS

BY PAUL WINSOR, CHAIRMAN; C. B. VOYNOW, RODNEY HITT

The committee recommends that the standing committees of the association make all necessary investigations and definite recommendations regarding proposed standards and that the functions of the committee on standards be confined to reviewing such recommendations before they are presented to the association in convention for discussion and reference to letter ballot. The form of letter ballot used in voting on the question of standards and the method of apportioning the votes of each member company are matters for joint consideration by the executive committees of the American Association and the Engineering Association. Therefore, this committee has not attempted to cover any of the details of the final voting for the adoption of standards by letter ballot.

The committee has prepared the following rules covering the procedure in the adoption of standards up to the time of their submission to letter ballot, and recommends that these rules be adopted and put into effect:

PROPOSED RULES FOR THE ADOPTION OF STANDARDS

1. Suggestions for new standards or changes in existing standards may be submitted in writing at any time to the president or secretary of the Engineering Association.

2. The secretary shall submit such suggestions to the executive committee at a meeting or by mail. The executive committee at its discretion may refer the suggestions to a proper committee with instructions to investigate the subject and report to the committee on standards.

3. The committee on standards shall consist of the chairmen of each of the standing technical committees of the Engineering Association; an equal number of members of the association, representing each of the branches of electric railway engineering, which are represented by the several standing technical committees; one member at large. The secretary of the Engineering Association shall be the secretary of the committee on standards.

4. Not later than July, the chairman of each committee of the association shall make a report in writing to the committee on standards of all matters relating to proposed standards which have been referred to such committee during the year. With the consent of the executive committee any committee of the association which has had the matter of a proposed standard submitted to it may make recommendations, covering such proposed standard directly to the convention, if the recommendations cannot be submitted in time to the committee on standards. In all cases the reports of the chairmen of committees relating to proposed standards shall contain definite recommendations with reasons in one of the following forms:

(a) "That further investigation is not warranted."

(b) "That the committee be given more time to investigate."

(c) "That the proposed design, practice or specification, which shall have been put in final and proper form by the committee reporting, be adopted as standard."

(d) "That the proposed design, practice or specification be adopted as recommended practice."

5. The committee on standards shall meet during July to consider these reports. The committee shall consider these reports with a view—

(a) To the needs of the member companies.

(b) To the manufacturing and commercial interests involved.

(c) To possible conflict with existing practices or equipment.

6. No standard or recommended practice shall be approved which will tend to create a commercial monopoly.

7. A vote of the committee on standards shall be obtained, by mail, if necessary, on all recommendations submitted to it and two-thirds affirmative vote of the committee shall be required for approval.

8. The committee on standards may approve recommendations as submitted, or may disapprove, giving reasons for disapproval. Both minority and majority reports must be printed and distributed to member companies and all associate members four weeks prior to the convention.

9. The committee on standards may change a recommendation made by a standing committee from standard to recommended practice, but shall have no authority to change such a recommendation from recommended practice to standard. In case the committee on standards finds it necessary and desirable to change materially the wording or the design of a proposed standard or recommended practice submitted to it by a standing committee, it may refer back such proposed standard or recommended practice to the committee from which it was received, stating the reasons which require such change to be made.

10. The majority report and minority report, if any, of the committee on standards shall be submitted to the convention for discussion and disposition.

11. Any proposed standard not already passed on and approved by the committee on standards, or any proposed standard modified in any way by the convention shall be submitted to the committee on standards immediately following the convention.

12. Any standard approved by the committee on standards and the convention shall be forwarded through the secretary of the association to the executive committee. Any standard approved by the convention and forwarded to the committee on standards for action (Article 11) shall be considered promptly by the committee on standards and approved or disapproved. A two-thirds affirmative vote of the whole committee on standards shall be necessary for approval. The result of the vote, with the minority and majority reports, if any, stating the reasons of the members of the committee, shall be forwarded to the executive committee through the secretary of the association.

13. Any standard or recommended practice approved by the committee on standards and the convention, or by the convention and the committee on standards, shall be forwarded by the executive committee of the Engineering

Association to the executive committee of the American Association, with the recommendation that a letter ballot of the members of the American Association be taken thereon.

14. The secretary of the Engineering Association shall announce the vote on all letter ballots relating to the adoption of standards and recommended practices by a circular letter which shall be sent to all members and associate members as soon as possible after a count of the vote has been made, or in such other manner as the executive committee may prescribe.

15. The committee on standards shall hold office until the new committee is appointed by the executive committee following the convention.

16. Each volume of the proceedings of the Engineering Association shall embody a reprint of all standards and recommended practices of the Engineering Association. Such reprint shall appear in the volume with complete data as to the date of adoption as standard or recommended practice and complete references by volume and page numbers to all reports or discussions relating to such standard or recommended practice.

17. In the event of this reprint of standards and recommended practices becoming too bulky, or for other valid reasons, the executive committee may order it printed as a separate volume, but each member and associate member shall be entitled to receive a copy of such separate volume each year when the bound volumes of the proceedings are distributed.

18. It shall be the duty of the committee on standards carefully to go over, and if necessary, revise this reprint of standards and recommended practices each year before it is reprinted.

REPORT OF COMMITTEE ON STANDARDS

BY PAUL WINSOR, CHAIRMAN; H. H. ADAMS, M. V. AYRES, M. H. BRONSDON, A. F. HOVEY, E. R. HILL, E. B. KATTÉ, J. M. LARNED, F. G. SIMMONS, L. P. CRECELIUS, CHARLES HEWITT, J. H. HANNA AND MARTIN SCHREIBER

The matters referred to your committee by last year's convention were as follows:

FROM 1910 COMMITTEE ON EQUIPMENT

(a) Rolled Steel Wheels of Light Design for One Wear.
(b) Proposed Standards for Rolled Steel Wheels.
(c) Gage for Mounting Wheels, both Steel and Chilled.
(d) Standard Taper for Pinions.
(e) Specification for Wrought Iron Bars.

FROM 1910 COMMITTEE ON WAY MATTERS

(f) Specifications for Open Hearth Steel Rails.
(g) Rules for Gage of Track on Curves.
(h) Layouts for Track Switches, Mates and Frogs.
(i) Symbols for Recording Surveys.

A meeting of the committee was held at New York City, September 13, 1911, and the following action was taken:

ROLLED STEEL WHEELS OF LIGHT DESIGN FOR ONE WEAR

Upon the recommendation of the executive committee your committee recommends that this matter be again referred to the committee on equipment for further consideration.

PROPOSED STANDARDS FOR ROLLED STEEL WHEELS

Your committee has considered the recommendation of the committee on equipment that the dimensions for rolled steel wheels, shown in Fig. 2, be adopted as standard. Owing to the state of the art, and also to the fact that this question is now being investigated by a committee of the American Society for Testing Materials, on which the American Electric Railway Engineering Association is represented by a sub-committee of the committee on equipment, your committee holds that the time is not ripe for their adoption as standard. The committee recommends instead that these dimensions be adopted as "Recommended Practice."

Instructions should be issued to the committee on equipment for 1911-1912 to consider the question of dimensions of rolled steel wheels of diameters smaller than 33 in.

GAGE FOR MOUNTING WHEELS, BOTH STEEL AND CHILLED

The committee approves the recommendation of the committee on equipment for 1910 that the gage shown in Fig. 1 be adopted as "Recommended Practice."

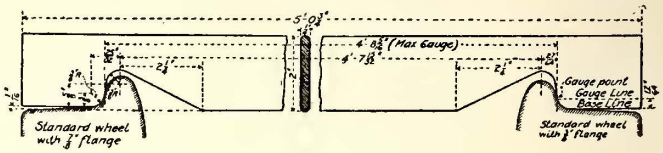


Fig. 1—Standards—Wheel Gage Proposed as Recommended Practice

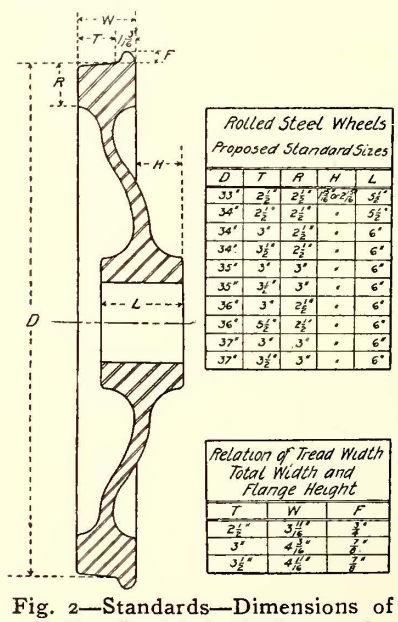
STANDARD TAPER FOR PINIONS

The committee approves the recommendation of the committee on equipment for 1910 that a taper for bore of pinions made in the proportion of 1¼ in. diameter to 1 ft. in length be adopted as "Standard."

SPECIFICATION FOR WROUGHT IRON BARS

The committee on equipment for 1910 recommended that the revised standard specifications for wrought iron of the International Association for Testing Materials forming Bulletin No. 24, June, 1901, of that association be adopted as standard except in regard to the clause governing "inspection" which it recommended be stricken out, and the similar clause contained in the specifications recommended by the committee on standards for 1909 be substituted.

In view of the fact that this subject is now under consideration by a committee of the American Society for Testing Materials, on which the engineering association is represented by a sub-committee from the committee on equipment, your committee does not approve the recommendation of the committee on equipment for 1910, but suggests instead that the matter be referred to the committee on equipment for 1912 for further investigation in conference with the American Society for Testing Materials.



Rolled Steel Wheels
Proposed Standard Sizes

D	T	R	H	L
33"	2½"	2½"	1⅞ or 2⅛	5½"
34"	2½"	2½"	"	5½"
34"	3"	2½"	"	6"
34"	3½"	2½"	"	6"
35"	3"	3"	"	6"
35"	3½"	3"	"	6"
36"	3"	2½"	"	6"
36"	3½"	2½"	"	6"
37"	3"	3"	"	6"
37"	3½"	3"	"	6"

Relation of Tread Width Total Width and Flange Height

T	W	F
2½"	3 11/16"	3/4"
3"	4 5/16"	7/8"
3½"	4 15/16"	1"

Fig. 2—Standards—Dimensions of Rolled Steel Wheels Proposed as Recommended Practice

SPECIFICATIONS FOR OPEN-HEARTH STEEL RAILS

Your committee approves the recommendation of the committee on way matters for 1910 that the specification for open-hearth steel rails drawn by it be adopted as "Recommended Practice."

RULES FOR GAGE OF TRACK ON CURVES

Your committee does not approve the recommendation of the committee on way matters for 1910 that the rules for gage of track on curves drawn by it be adopted as standard. Such action is not warranted at the present time. Your committee recommends instead that the aforesaid rules be adopted as "Recommended Practice."

LAYOUTS FOR TRACK SWITCHES, MATES AND FROGS

Your committee does not approve of the recommendation of the committee on way matters for 1910 that the layouts for track switches, mates and frogs drawn by it be adopted

as standard. Such action is not warranted at the present time. Your committee recommends instead that the aforesaid layouts be adopted as "Recommended Practice."

SYMBOLS FOR RECORDING SURVEYS

Your committee does not approve of the recommendation of the committee on way matters for 1910 that the symbols for recording surveys drawn up by it be adopted as standard. Such action is not warranted at the present time. Your committee recommends instead that the aforesaid symbols be adopted as "Recommended Practice."

REPORT OF COMMITTEE ON EQUIPMENT

BY M. V. AYRES, CHAIRMAN; H. A. BENEDICT, VICE-CHAIRMAN; A. T. CLARK, F. R. PHILLIPS, H. L. PATTERSON, HOMER MAC NUTT, F. G. GRIMSHAW, W. THORN, J. M. BOSENBURY

Sub-committees were primarily responsible for the discussions of the following subjects; but the material in its final form has been more or less modified by the action of the committee as a whole.

HEATING AND VENTILATING CARS

This is a study of the relative desirability and economy of various systems, and it includes an appendix prepared by Messrs. Thorn, Benedict and Clark. It is recommended that the association collect data which will show the effect of various systems of car heating on the insurance rates for cars and buildings. This data should cover the entire country, affording a comparison of the practice of the insurance companies in different districts.

DESIGN OF CAR BODIES FOR LIGHT WEIGHT

The advance in the art of car body design has received added impetus in the past few years through the introduction of steel shapes and pressed plates for the principal stress members and a growing tendency on the part of equipment engineers and builders toward the application of engineering principles in the design. The laws governing the determination of the strength of materials and the distribution of the stresses are well known and adequate. It is gratifying to note that car designers are thoroughly alive to the advantages of applying engineering principles to such problems rather than accepting a design based on the "rule of thumb" methods heretofore in general use.

DESIGN OF CAR TRUCKS FOR LIGHT WEIGHT

The possibility of reduction in weight of trucks appears to lie chiefly in the careful design of detail parts. Much has already been accomplished on these lines by various designers and descriptions are given of several light-weight trucks.

DESIGN OF LIGHT-WEIGHT ELECTRICAL CAR EQUIPMENT

The electrical manufacturing companies are fully alive to the growing demand for lightening equipments, and are attacking the problem along several lines that seem promising.

MORE UNIVERSAL STANDARD OF COMPARISON OF CAR WEIGHTS

Opinions differ as to whether or not the seats, lighting and heating equipment, fare register, sand boxes, foundation brake rigging and other accessories should be classified as a part of the car body or be assigned a separate classification. The committee would recommend that the whole car and equipment be divided into five main divisions, as follows:

1. Car bodies.
2. Car-body accessories.
3. Power brakes.
4. Trucks.
5. Motive power equipment.

(1) The car body includes all parts of the underframe, superstructure, roofs, platforms, interior finish, doors with their hinges and latches, window sashes and sash locks, and everything above the center plates not assigned to some other division. Both center plates are part of the trucks, and the truck center pin is part of the car body.

(2) Car-body accessories include in general everything usually supplied with a car body, but readily detachable therefrom, and not assigned to any other classification.

(3) Power brakes include compressor and governor, tank, piping, cylinder, cylinder levers and connecting rod, and pull rods to the truck live lever or radius bar; also all wiring, switches, fuses, conduit, etc., connected with compressor and governor, and all hangers and attachments for supporting any of the above.

(4) Trucks include both center plates, brake beams, shoe heads and shoes, live and dead truck brake levers and radius bar, motor support, wheels and axles, and all parts obviously belonging to the truck; also such fenders, pilots and wheel guards as are attached to the trucks. Motor gears are not included in the truck.

(5) Electrical equipment includes motors, with gears and gear cases, rheostats, control equipment, all wires, cables, conduit, circuit breakers, and fuses required in the operation of this motive power, all supports for same, trolley poles, wheel and bases, and trolley boards.

SEATING CAPACITY

It is customary to compare cars on the basis of their seating capacity. This unit of comparison is not altogether satisfactory but will, doubtless, continue to be used on account of its convenience. One of the disadvantages of this unit at present is the uncertainty as to what constitutes a "seat."

Seat dimensions vary widely, as does the distance between transverse seat centers. It is suggested that the following are fair general values for the dimensions: Width of seat at hip line, 17 in.; height of seat, 17 in.; height of back, 17 in.; distance between centers of transverse seats, 30 in. It is not recommended that the seating capacity of cars be computed in accordance with the above figures in entire disregard of actual seating arrangements, but it is suggested that the dimensions given be used in determining the seating capacity of car spaces not provided with seats, such as baggage compartments, and also in determining the seating capacity of long longitudinal seats.

STANDARD COUPLERS FOR INTERURBAN SERVICE

The subject of standard couplers for interchange with steam railroad equipment was suggested by the Central Electric Railway Association. That association recently adopted as standard a coupler of the M. C. B. type, but equipped with certain auxiliary features not applied to steam equipment cars, and the question was presented for the consideration of this committee as to whether it should recommend the adoption of this coupler to the Engineering Association as a whole, either as a standard or as recommended practice.

This committee consulted with representatives of certain of the traction coupler manufacturers and investigated coupler conditions on a number of electric roads in the Central West where the need for automatic couplers in regular operation is perhaps most strongly felt. As a result, your committee feels that some form of automatic coupler will likely finally be required. The handling of steam road equipment by electric roads is a matter already prominently before certain companies. This interchange of equipment is certain to increase and to entail the use on electric cars of couplers that will automatically couple with steam equipment. It is, therefore, the opinion of your committee that any automatic coupler adopted as standard by the American Electric Railway Association for use on interurban cars should be of the vertical plane M. C. B. type. The height of center line of standard couplers and drawbars should be 34½ in. above top of rail measured from the center line of coupler.

Many roads have adopted couplers of standard M. C. B. contour, or, in lieu thereof, couplers embodying in their

construction the essential features of the M. C. B. coupler but containing certain additional parts not found in steam railroad practice. The need for these additions to the M. C. B. coupler is felt by certain roads that are required at times to operate trains consisting of two or more cars coupled together over tracks in which there are sharp degrees of curvature and sudden changes in grade; the former requiring that the couplers be radial and the latter that they shall be so designed as to prevent uncoupling vertically due to vertical displacement of the adjacent couplers from the same horizontal plane.

The use of a vertical plane coupler of the M. C. B. type with radial drawbar also introduces considerations of resistance against lateral buckling under heavy pushing strains, or under sudden brake applications where there is a variation in the braking effect on cars in the same train. The practice followed by different electric roads using M. C. B. type couplers in providing special attachments on their couplers to safeguard them against vertical uncoupling and lateral buckling is not, however, uniform. Some roads use couplers with such attachments while others have considered them unnecessary and have either not provided them at all or, after trial, have discontinued their use.

The committee feels that this question has become so acute on many of the interurban roads that an early adoption of a standard coupler is urgently needed; and it regrets that the complexity of the problem, and the lack of agreement among those who have had most experience with it, render it impossible to make a definite recommendation at this time.

As an indication of the gravity of the problem may be cited the fact that one large system has spent $125,000 experimenting with the coupler question, and has adopted an M. C. B. type of coupler entirely different from that standardized by the Central Electric Railway Association.

The committee is agreed that the following requirements are essential to the coupler to be finally adopted as standard for interurban use:

REQUIREMENTS FOR INTERURBAN COUPLER

1. Must have substantially the M. C. B. contour, and must couple automatically by impact with all M. C. B. couplers now used by steam roads.
2. Must have radial drawbar.
3. Must provide for successful operation over irregularities of grade met in interurban service.
4. Shank of coupler head should be of such dimensions that in case of emergency it can readily be replaced by an M. C. B. passenger coupler.
5. Must be so constructed as to limit lateral movement in the heads so that the angle between longitudinal axes cannot exceed 8 degrees when any two interurban couplers are coupled together. Construction used for this purpose must be strong enough to withstand severe strain in coupling under impact, and in pushing around curves.
6. All makes of interurban couplers, to comply with these requirements, must couple and operate properly with each other.
7. There must be an arrangement permitting uncoupling without requiring the operator to pass between the cars.
8. The face of the knuckle should be 11 in. minimum and 16 in. maximum, and preferably should be provided with a slot for the use of a shackle bar.

In addition to the above requirements the interurban coupler should operate successfully with steam-road equipments over the widest practicable range of conditions, although it is doubtless impossible to produce a coupler which will operate with steam-road couplers under all conditions of short radius curves and irregularities of grade as found in interurban service.

The great difficulty of determining the essential details of the interurban coupler arises from the fact that different and irreconcilable methods are used and advocated for meeting certain of the requirements as above set forth. A discussion of these differences follows:

Breaks in Grade.—Irregularities of grade as met in interurban service produce variations in height between adjacent bumpers, amounting sometimes to 12 in. or more. Two principal methods are used to make the couplers operate properly under these conditions.

One is the locking together of the couplers so as to eliminate vertical movement between them, and the provision of means to permit great vertical movement of the drawbar.

The other provides a very high knuckle, 16 in. being the height used by one company. This high knuckle is of full M. C. B. contour at the middle portions, and tapers at top and bottom to permit angular movement in a vertical plane. The drawbar is so supported as to prevent its vertical movement.

Limiting Lateral Movement.—To limit lateral movement between coupler heads two different principles are in use. The older device provides an extension on the guard-arm side, and a shelf on the knuckle side, so proportioned that when coupled together the shelf and extension mutually interact to limit lateral movement. This device is not patented, and standard dimensions could be adopted to secure uniformity. It also helps to align the knuckles when coupling and reduces the danger of the couplers kicking violently to one side with possible disastrous results. It is, however, when made strong enough, somewhat heavy and clumsy.

Another method, part of a patented device, employs a latch-piece in the center of the coupler head engaging with a vertical slot in the outside face of the knuckle, in such a manner as to limit to a very small amount both lateral angular movement and vertical movement. Two couplers of this type operate very well together, but the device is totally inoperative with the bracket and shelf type, although it does not prevent intercoupling therewith.

At least one coupler manufacturer claims that no device to limit lateral movement is necessary, and there are some interurban roads operating M. C. B. coupler without such a device; but it is the opinion of your committee that under the more severe conditions of interurban work strains are produced in the standard M. C. B. coupler with radial drawbar sufficient to break or distort the coupler; and it regards a device to limit lateral movement as necessary to meet these conditions.

Your committee had hoped to arrange for a demonstration under actual service conditions of the various M. C. B. type traction couplers now on the market, including couplers of the design submitted by the Central Electric Railway Association, in order that it might judge as to the departure from the standard M. C. B. lines, that should be incorporated in a satisfactory standard automatic coupler for electric railway purposes. It was, however, unable to make the desired arrangements and the idea was abandoned for the present year, but it is strongly of the opinion that an actual service test under varying conditions as found in electric railway practice should be made before definitely recommending any coupler as standard.

The committee suggests that the subject of standard couplers for interchange with steam railroad equipment be referred back to the committee for next year, with instructions to arrange for and make such tests as will demonstrate clearly the requirements based on the results obtained therefrom.

STANDARD AIR, SIGNAL AND CONTROL CONNECTIONS

The subject of air, signal and control connections was hardly touched in the committee's discussion, and it suggests that it be referred to the committee for further consideration

JOINT SUB-COMMITTEES WITH AMERICAN SOCIETY FOR TESTING MATERIALS

In accordance with instructions from the president and in conformity with the agreement entered into with the American Society for Testing Materials, the chairman of the committee on equipment has appointed two sub-committees to work with the committees of that society. These sub-committees are as follows:

Sub-Committee on Standard Specifications for Steel Wheels.—H. A. Benedict, mechanical engineer, Public Service Railway Company, Newark, N. J.; E. W. Holst, superintendent equipment, Bay State Street Railway Company, Boston, Mass.; Henry J. Gulick, Jr., Gulick-Henderson Company, Pittsburgh, Pa.

Sub-Committee on Standard Specifications for Wrought Iron.—C. G. Young, consulting engineer, New York, N. Y.; A. T. Clark, superintendent rolling stock and shops, United Railways & Electric Company, Baltimore, Md.; Carl F. Woods, secretary, Arthur D. Little, Inc., Boston, Mass.

In addition to the two above named, a third similar sub-committee, dealing with a subject within the province of the committee on equipment, has been appointed, but by agreement this committee was named by the chairman of the committee on heavy electric traction. This committee is as follows:

Sub-Committee on Standard Specifications for Steel Axles.—J. S. Doyle, superintendent car equipment, Interborough Rapid Transit Company, New York, N. Y.; John Lindall, superintendent motive power and rolling stock, Boston Elevated Railway Company, Boston, Mass.; Hugh Hazleton, Hudson & Manhattan Railroad Company, New York, N. Y.

None of these sub-committees had completed its work at the time of preparing this report.

STEEL WHEELS FOR ONE WEAR

A large concern manufacturing steel wheels has called attention to the fact that it is now prepared to furnish light steel wheels intended for one wear without turning, as recommended in last year's committee on equipment report.

SQUEALING OF STEEL WHEELS

The superintendent of rolling stock of a large city system has written a letter asking the committee to investigate the cause of and remedy for the squealing of steel wheels when brakes are applied. He states that this is proving a very serious problem with his company. This communication came too late for consideration by the committee this year, and it is mentioned here with the hope that some one may be able to suggest a remedy.

END PLAY OF AXLES WITH STANDARD JOURNALS

An engineer of one of the large truck manufacturing companies urges the reconsideration of our truck journal bearing design with a view to a more effective means of limiting end play. He claims that the so-called M. C. B. journal, as standardized by this association, is deficient in this particular when used in electric railway service, and that the excessive end play which very soon takes place is the cause of many truck troubles not always traced to their proper cause. He particularly specifies broken brake hangers, worn-out gear cases, and a general racking and loosening of the entire truck frame. This question was raised in last year's question box, but did not receive very much attention.

APPENDIX I—HEATING AND VENTILATING CARS, BY MESSRS. THORN, BENEDICT AND CLARK

Cars can be heated by several means, but those usually employed are among the following: (1) Coal stoves, direct methods; (2) coal stoves, indirect method, similar to hot-air furnace used for heating houses; (3) hot-air heaters, air blast, motor driven; (4) hot-water heaters, and (5) electric heaters.

CARDINAL POINTS OF HEATER DESIGN

In order to bring out the characteristics of the various methods of heating cars, they should be considered with regard to the following points:

1. Ability to heat car to uniform temperature.
2. First cost, completely installed on car.
3. Maintenance, including repairs, renewals, replacements, etc.
4. Cost to operate. In the case of hot-water heaters, this will include fuel and labor only; in the case of electric systems, power only, and in the case of the hot-air blast heater using coal—fuel, labor and power.
5. Weight of system complete as installed on the car ready to operate.
6. Fire risk.
7. Reliability.
8. Regulation. This refers to ability to regulate the heat according to the outside temperature.
9. Space occupied.
10. Appearance.
11. Attention required from car crew.
12. Cleanliness, which will include freedom from dust, ashes and obnoxious gases.
13. Adaptability and relation to ventilation systems.

Heating systems which are very economical in a city having a mild climate and favorable load conditions would not be desirable in another city having more severe climatic and load conditions. The type of car operated, whether single end or double end, has a bearing on the most desirable method of heating. Considerations of space, regulation, weight and appearance may be the governing ones, instead of net operating economy. There is no one heating system which is the most economical and desirable for all cases, since each case has its own peculiar conditions.

THE HOT-AIR HEATER

In this system the air is heated by a coal fire and forced through suitable ducts along the side of the car by a motor-driven fan. By its use it is possible to secure quite uniform heating of the car. The heat being applied along the floor line results in dry floors, which is a very strong point in its favor. The first cost is rather high, but as the equipment becomes better developed this cost should be somewhat lower.

The maintenance of this system is considerable, but exact data are not yet available. The cost to operate including only the items of coal, labor of attendance and cost of electricity for the motor, is comparatively low. The weight depends on type and size of car, but is practically the same as electric, and less than hot-water heaters. The fire risk is practically the same as in the case of hot-water heaters. The reliability of the heater in its present state of development seems to be an open question. The regulation is not so good as it should be, but will undoubtedly improve as the apparatus is further developed. When this system is used in conjunction with exhaust ventilation, the regulation is better. The space occupied is perhaps greater than with hot-water heaters. The appearance compares favorably with other types of coal heaters. Considerable attention is required from the car crew from time to time in order to keep fire in proper condition, but where the heater can be placed near the conductor or motorman this is readily accomplished. It is not so clean as the electric system, but compares favorably with hot water. This system being designed to provide for ventilation, it is readily adapted to that end.

THE HOT-WATER HEATER

This system possesses many valuable characteristics, among which are independence of the electric power supply, which is quite a consideration in interurban work where long runs are made and the power supply is subject to interruption. By use of this type of heater it is possible to heat the car very uniformly. The efficiency of hot-water heaters will fall off materially if the pipes and coils are not kept reasonably free from scale and other deposits.

The first cost is not so high as that of the hot-air system. The maintenance is higher than that of the electric system. The cost to operate, including only the items of fuel and labor, is approximately the same as for the hot-air heater. The weight of the hot-water apparatus is high and has long been one of its chief drawbacks, but the latest types show improvement in this respect. The fire risk is substantially the same as for the hot-air heater. In case of wreck there is a hazard from the fire in the coal stove. The reliability is very good. The regulation is comparatively poor, because it takes considerable time for water to take up heat and, conversely, it takes some time for water to lose its heat.

The space occupied is considerable and, except on single end cars, this space is valuable as seating or standing room. The hot-water heater with its expansion drum, water-glass gage, etc., does not add to the appearance of a car, except where it is practicable to partly inclose the apparatus. Considerable attention is required from time to time, but the work is small and where heater can be located close to one of the crew it does not take him from other duties. The hot-water heater as usually installed produces considerable dust, and very frequently obnoxious gases. The heating elements being pipes located one above the other near the floor line, it is easy to adapt this system of heating to any practical scheme of ventilation.

THE ELECTRIC HEATER

With this type of heater it is perfectly possible to secure uniform temperature throughout the car. The first cost is lower than that of any of the other modern systems. When the electric heater is carefully installed with wiring in conduit, the maintenance is very low, being considerably less than that of any of the other modern systems. The cost to operate, which includes power only, is variable. In general, the cost of operation is high. There are many cases, however, where this method of heating will show the greatest net economy.

The weight is the least of any of the modern heating systems, except in some cases, where it is practically the same as the hot-air heater. Where the wiring is properly installed in conduit the fire risk is practically nil. This system is very reliable. The regulation is the best of all, it being possible to follow closely and without trouble rapid changes in outside temperature. The space occupied is very small and is not useful for standing or seating capacity. The appearance of such parts as are exposed is very neat. The electric heating system requires the minimum amount of attention from the car crew. This type of heater is clean and free from dirt or obnoxious gases. The heating units, being subdivided and located under the car seats or along the truss plank, are readily adaptable to any practical system of ventilation.

TOTAL COST FOR ONE YEAR CHARGEABLE TO CAR HEATING.

	Electric heater.	Hot water heater.	Hot air heater.
Cost of power	$137 03	...	$8 22
Repairs and maintenance	1 09	$4 35	2 90
Interest and depreciation	8 80	18 75	18 60
Coal	.....	47 76	47 76
Labor of attendance	.....	8 70	8 70
Hauling (4 cents per lb. per year)	20 00	60 00	20 00
Insurance charge	.....	12 00	12 00
Total cost per car	$166 92	$151 56	$118 18

The above figures are based on the following data and assumptions:

	Electric heater	Hot water heater.	Hot air heater.
First cost, installed	$80	$125	$155
Interest and depreciation	5% and 6%	5% and 10%	5% and 7%
Weight installed	500 lb.	1500 lb.	500 lb.
Coal consumption per day	.....	85 lb.	85 lb.
Power consumption	5.0 kw. average for heating season	....	0.3 kw.
*Repairs and maintenance	¾c. per day	3c. per day	2c. per day
Cost of car	$6,000	$6,000	$6,000
Investment in barns per car	$1,500	$1,500	$1,500
Hours per day per car	13½	13½	13½
*Labor of attendance	.....	6c. per day	6c. per day
Heating season	145 days.	145 days.	145 days.
Extra insurance over electric heaters on barns	....	10c. per $100	10c. per $100
Extra insurance over electric heaters on cars		17½c. per $100	17½c. per $100

* Per day of heating season.

COMPARATIVE COSTS

To bring out clearly the comparison in costs of heating a car by the three modern systems, the accompanying estimate may be of interest. The figures in each case are based, in general, on results obtained in practice and are considered fair and reliable.

Assumptions.—32-ft. car body; heating season, 145 days; lowest temperature, about zero; municipal requirements, 50 deg. Fahr.; cost of power, 1.4 cents per kw-hour at the trolley; cost of coal, $7.75 per ton.

Under the conditions assumed, the relative total economy of the three principal heating systems is as follows: Hot-air system, first; hot water, second; and electric, third.

In figuring the power consumption of electric heaters, the following method will probably give the most accurate results. Obtain from the weather bureau temperature readings for each winter for several years. Plot a curve showing variation of temperature for each day of the heating season. Find what point of heat is carried for the different temperatures and then a power curve can be plotted from which the average kw per day can be readily obtained.

In the use of hot-water or hot-air heaters there is a tendency on the part of the car crew to use less coal than would have to be used if the cars were kept at a uniform temperature during the time they are in service, while with electric heaters the tendency is to put on three points when two points would suffice. This gives rise to false ideas of the relative costs of the various heating systems.

In the installation of electric heaters it is preferable to have a comparatively large number of heaters rather than a few, even though the power consumption is on the same basis, on account of the better distribution of the heat. For localities where the temperature reaches zero or lower it is well to have about 4.5 watts per cubic foot of car body, otherwise it may be difficult to keep the cars comfortable when low temperatures prevail.

When a practical, low-cost heater regulator is brought out and comes into general use the cost of electric heating will be very largely reduced. Tests have been made which indicate that the saving in power by the use of thermostat regulators will be in excess of 50 per cent.

The cost of car heating would be somewhat reduced and the comfort of passengers considerably increased if storm sashes were more generally used. The difference in temperature on some cars in the Middle West with the same heating equipment—one with storm sashes, one without, and running together on the street—was about 9 deg. Fahr.

The maintenance of heating systems would be greatly reduced if more care were given to the installation of new equipment. This is particularly true of electric heaters.

VENTILATION—MONITOR DECK WINDOWS

The usual method of obtaining ventilation in electric railway cars has been to provide a monitor deck or clerestory in which are a number of small windows that can be opened. The ventilation afforded by these small windows is largely by dilution; that is, such air as may enter serves to freshen the air in the car. The chief objection to the system is that under some conditions of operation strong drafts are created which are objectionable to passengers.

Authorities differ as to the amount of air to be supplied per person per hour, in order to provide a reasonable standard of air purity. An ordinance of the city of Chicago on this subject calls for the supply of 350 cu. ft. of air per hour per passenger (based on maximum standing and seated load); provided, however, that the air in the car shall at no time show more than 10 parts of CO_2 in 10,000 parts. It was found possible to meet these

requirements by any one of a number of ventilating systems.

TYPES OF VENTILATORS

Ventilation systems other than monitor windows have been worked out principally along two lines; those operated by the movement of the car through the air and those operated by motors. The first are usually called the automatic systems and the second mechanical systems. Automatic ventilators are usually "exhausters," and should be so designed as to exclude rain and snow and to prevent gusts of air coming into the car. The action of automatic systems is, of course, variable, depending on the velocity of the car and the direction and force of the wind. The mechanical systems, of which there are two principal kinds, the "exhauster" type and the "blower" type, are positive and practically independent of motion of the car or velocity of the wind.

MECHANICAL SYSTEM

A typical mechanical system consists of a motor-driven exhaust fan located on the vestibule roof, or other practical point, an exhaust chamber formed in the upper ceiling of the car, openings located at various points in the ceiling and intakes located at several points in the floor and connected to the electric heaters. The cold air thus is made to pass over the heating surface before coming into the car body. Tests show that consumption of power for heat is not increased by this method. The fan-motor set consists of a very generously designed ½-hp motor, direct connected to a specially designed 9-in. cone fan. This fan will handle about 33,000 cu. ft. of air per hour under normal coditions of line voltage. The motor is connected direct to the 500-volt trolley circuit through a standard combination snap switch and fuse, and is started and stopped by means of this switch. The motor and fan are mounted in a suitable metal housing which is connected to the exhaust chamber. The fan discharges through protected openings in each side of the housing. The exhaust chamber in the upper part of the car is formed by lowering the ceiling about 4 in. from the roof framing and is continuous from end to end of the car body. Communication between the car interior and the exhaust chamber is provided by fourteen openings, each containing a circular adjustable register. By proper adjustment of the registers a uniform velocity of air through all of them is obtained. The intakes are eight in number, four being located on each side of the car under the seats in such a manner as to be readily connected to the electric heaters. The connection between the screened opening through the car floor and the electric heater is made with a pressed metal duct. The size and number of the intakes is such as to permit of a maximum velocity of the air of about 400 ft. per minute, which is hardly perceptible to passengers.

AUTOMATIC SYSTEMS

The automatic systems installed are of several different kinds, but all depend upon aspirator action for their operation. One of these automatic systems which has shown fair results comprises a number of "exhausters" located along each side of the monitor roof and attached to panels placed in the monitor or deck window openings. An opening in the panel communicates with the "exhauster." These "exhausters" are also designed for use with arch roof cars. Intakes similar to those described in connection with the mechanical system are located in the floor and provide a supply of fresh air. The "exhausters" are rectangular sheet-metal boxes projecting outwardly from the panels to which they are secured, having openings top and bottom, and provided on the middle of each side face with V-shaped projections. The "V" projections are placed horizontally on the faces of the "exhausters" and "split" the air into two streams, one following upward and the other downward. The air streams flow past the openings of the "exhauster" and by induction "draw" the air out from the car.

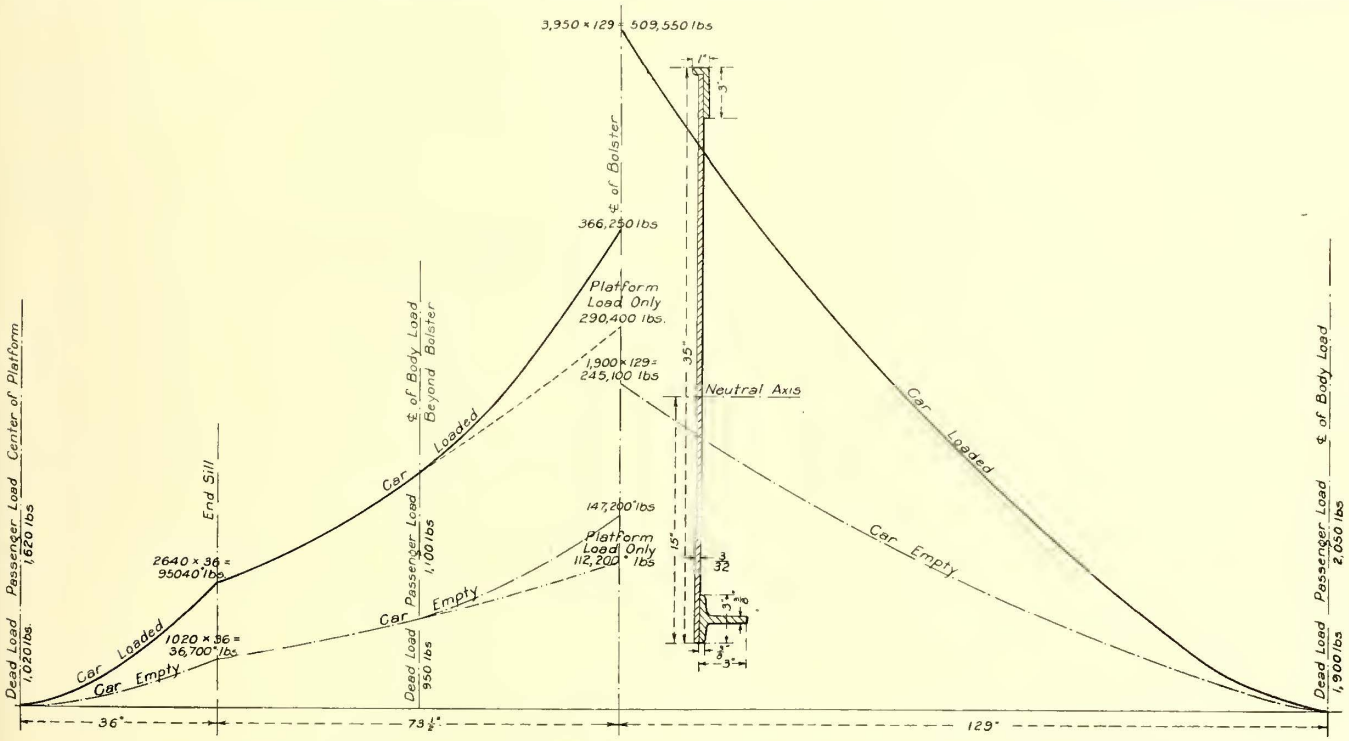


Fig. 1—Equipment—Stress Diagram of Plate Girder Car Side

From the result of tests, it is safe to say that there are now on the market several ventilation systems for cars which will provide a reasonable standard of air purity and which are not very high in first cost or cost of maintenance.

APPENDIX II—DESIGN OF CAR BODIES FOR LIGHT WEIGHT, BY MESSRS. PHILLIPS, THORN AND MACNUTT

Much progress has been made during the past few years in the reduction of car weights through the substitution of engineering principles for "rule of thumb" in car

design, and this progress has been characterized by a growing tendency toward the use of steel instead of wood in all stress members.

SIDE CONSTRUCTION

The plate girder straight-side design offers several advantages in simplicity, clearance and strength when compared with curved side, trussed wooden framing, and this style of construction seems to be rapidly gaining in popularity.

Fig. 1 shows a simple form of plate girder side frame, together with the moment diagram used in determining the stresses and the method of determining the section modulus. Fig. 2 shows the plate girder side frame of another car.

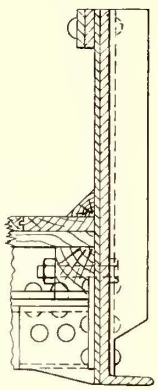


Fig. 2—Equipment—Plate Girder Side Frame

UNDERFRAME

The use of steel in the underframe is applicable to all types of cars. It has the advantages of great strength and low weight. The most important stress member of the underframe in a double-truck car is the bolster. The "diaphragm" type provides great strength with light weight and has practically solved the difficulties experienced with this part of the car body.

The cast-steel bolster is a close rival to the "diaphragm" type and is a vast improvement over the laminated steel and wood construction and the "built-up" type; but must be made under rigid specifications, such as those of the American Society for Testing Materials, and closely inspected in order to avoid the danger of faulty castings and excessive variations in section. Illustrations are presented of a typical "diaphragm type" bolster, a cast-steel bolster and a "built-up" bolster.

Perhaps the next most important members of the drop platform type of car are the platform knees and draft members and a study of the later designs will indicate that the "trussed knee" contains everything to be desired in the matter of strength, weight and simplicity.

SUPERSTRUCTURE

The problem of joining the wood superstructure with the steel parts in a satisfactory manner has in some cases

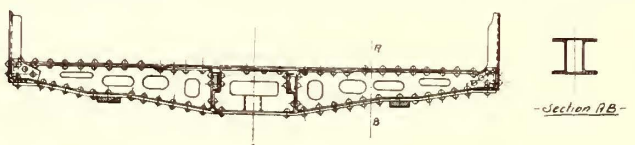


Fig. 3—Equipment—Diaphragm Type Body Bolster

proved exceedingly perplexing. Where wooden posts are used in connection with plate girder side frames the trouble has been solved satisfactorily by using steel posts.

Metal carlines have long been considered a necessary part of the roof construction in all types of cars and will continue to be used. In certain special car construction,

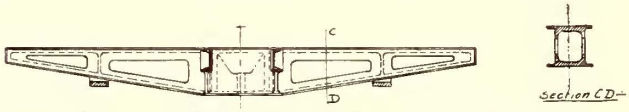


Fig. 4—Equipment—Cast-Steel Body Bolster

such as the all-steel roof, without ceiling, and for use in connection with the arched, mushroom or semi-arched roof, a pressed steel carline is probably preferable to the commonly used forged type.

A great deal of interest has lately been aroused by the return of the arched roof in the design of cars, but we find a great diversity of opinion existing as to the relative merits in comparison with the monitor roof. The arched roof embodies light weight, low first cost, simplicity and less liability of roof leakage, but it is claimed that the arched roof is inferior to the monitor type of roof in the matter of ventilation. This objection has little weight.

REDUCTION IN WEIGHT

Efforts toward reduction of car weights have met with unqualified success, resulting in some cases in a reduction of as much as 20 per cent in the car body weight and a net gain for the whole car of 6 to 8 per cent.

APPENDIX III—DESIGN OF CAR TRUCKS FOR LIGHT WEIGHT, BY MESSRS. BENEDICT, PHILLIPS AND CLARK

The cast-steel bolster of a type used with a short wheel-base city car weighs approximately 300 lb., which is materially lighter than former types. There is still room for much improvement, which can be brought about by more careful design. The castings can by judicious treatment be still further reduced in weight, probably to the extent of 10 per cent.

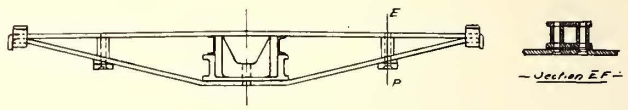


Fig. 5—Equipment—Built-up Bolster

MOTOR SUPPORT

In many cases the rectangular bar extending across the truck has been abandoned and in its stead two pieces of heavy angle iron are used. This one item has meant a saving of over 100 lb. per truck when two motors per truck are used.

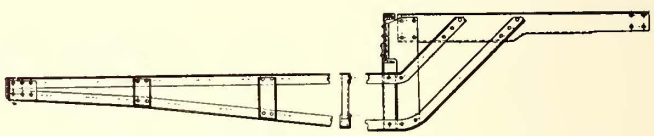


Fig. 6—Equipment—Trussed Platform Knee, Design A

BRAKE-SHOE HEADS

Brake-shoe heads are items in which there is room for considerable reduction, steam railroad freight car brake-shoe heads representing a very economical arrangement of the metal. There is a possibility that the weight of

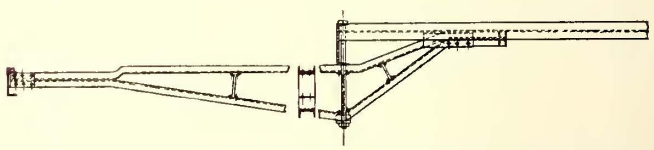


Fig. 7—Equipment—Trussed Platform Knee—Design B

each brake-shoe head can be reduced by from 10 to 30 per cent.

STRUCTURAL SHAPES

There appears to be many parts now made of a rectangular cross-section where the cross-section could readily be that of an I-beam, channel or angle. The result would

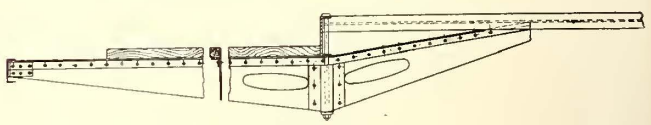


Fig. 8—Equipment—Trussed Platform Knee, Design C

be that the cross-section would be materially reduced. By applying this principle throughout the entire construction, it is quite likely that 100 lb. or more could be cut off almost all designs of trucks.

CASTINGS

The use of cast iron except for brake shoes and wheels should be abandoned, and all castings should be either cast steel or malleable iron. The lightening of the main body of the casting and the placing of reinforcement ribs will greatly lessen the weight of a casting. Almost all

large electric railways and truck builders have types of trucks that to a greater or less extent are standard. A profitable line of action would be to apply the designing skill of the engineers of both the user and manufacturer to reducing the weight of these types until the much sought for balance between strength and weight is found. Considerable progress has already been made by certain designers in producing lighter trucks, both by the process of redesigning cross-sections for maximum strength with minimum area and by the development of novel and improved designs for the truck as a whole.

To give some idea of this progress it has been thought well to give two illustrations and data of trucks recently built.

Figure 9 shows a motor truck for city service, 19,000 lb. center-pin load, with the following characteristics.

Service	City, motor
Center-pin load	19,000 lb.
Wheel base	54 in.
Gage of track	4 ft. 8½ in.
Weight of one truck, without wheels, axles or boxes	3,080 lb.
Weight, with 33-in. steel wheels, 5-in. axles with 4¼-in. by 8-in. journals, boxes, complete	6,950 lb.
Ratio, complete truck weight to center-pin load.	0.366

Figure 10 shows a trailer truck for city service (Phillips design), 17,500 lb. center-pin load, with the following characteristics:

Service	City, trailer
Center-pin load	17,500 lb.
Wheel base 4 ft. 4 in., gage of track 5 ft. 2½ in.	
Weight of one truck, complete, including 22-in. steel wheels, 4-in. axles, 3¾-in. by 7-in. journals	3,800 lb.
Ratio, complete truck weight to center-pin load	0.217

HALSEY RADIAL TRUCK

Figure 11 shows a novel design now being tried out on one large city system, the "Halsey Radial Truck." The design is so radical and on first inspection of such doubtful practicability that it would not have been included but for the fact that the car illustrated has been in regular daily service for more than half a year. It is stated that in practice this truck takes the curves perfectly and with a remarkable absence of flange wear. The car illustrated weighs 44,000 lb. with double trucks and four motors and 32,000 lb. with the radial truck and two motors, a saving of 13,000 lb., or 29½ per cent.

DESIGN OF ELECTRICAL EQUIPMENT OF CARS FOR LIGHT WEIGHT

In the effort to reduce weights of motors, several distinct lines of possible progress have been investigated, of which the following is a fairly complete list:

1. Redesign of motors, with special reference to elimination of unnecessary material.
2. Use of higher speed motors with greater ratio of gear reduction.
3. Forced ventilation.
4. Raising the working temperature by the use of heat-resisting insulation.
5. Field control.

In the elimination of unnecessary material considerable real advance has already been made both in the lightening of the motor frames and in the substitution of sheet metal for malleable castings for cover plates and gear cases. The use of sheet-metal gear cases has been attempted for several years with quite indifferent results, but it is believed that the problem has now been practically solved, partly by proper reinforcement and partly by the substitution of autogenous welding for riveting.

The use of higher speed motors has one argument in its favor, namely, that the output of any electrical machine increases, within limits, about in proportion to its speed. Unfortunately, high speed causes commutator trouble, creates centrifugal forces which are hard to overcome, soon reaches the limit of successful gear reduction and also causes bearing trouble. The present outlook does not seem to be very favorable for progress in this direction. The use of forced ventilation is already in very successful use in heavy locomotive work. There is no doubt that it affords means of very greatly increasing the steady load-carrying capacity of the motors. It does not increase the

Fig. 9—Equipment—Frame of Motor Truck for City Service

momentary power limitation of the motor, and with a motor already worked up to the safe limit of commutation it would not be of much use, but with modern motors of interpole construction there will hardly be any circumstances under which the heating will not be the practical limit of rating and ventilation an effective means of increasing the rating. In locomotive work it is customary to use a separate motor-driven blower attached to the body of the cab, which forces the air through a proper system of piping into the motors. It is very difficult to do this on the ordinary electric car on account of the extreme swing of the trucks and the restricted space available. One of the large manufacturers has attacked the problem by mounting the blower inside the motor case with the rotor attached to the armature shaft. This makes an almost ideal simplification of apparatus but seems to be open to the objection that the fan will suck in dirt and water as they are thrown up by the wheels and the wind against the under side of the car. If some effective means can be found of eliminating these objectionable materials from the air taken in by this method, it ought to prove very useful.

INSULATION

Raising the working temperature by the use of heat-resisting insulation has been tried in several instances with

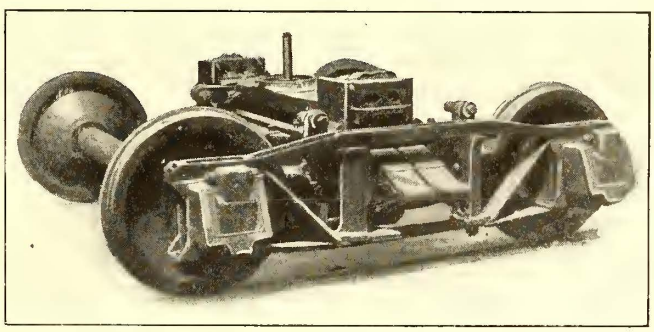


Fig. 10—Equipment—Trailer Truck, Phillips Design, for City Service

very encouraging results. Under some operating conditions with the older type motors it was hardly worth while to seek improvement in this direction, because the motors were also working quite close to the limit of commutating capacity. With the introduction of interpole construction this limitation is removed, and the possibility of operating at higher temperatures means greater horse-power from a given motor or a smaller or lighter motor for a given horse-power.

Asbestos and mica have been used with some success as heat-resisting insulating materials; but the most encouraging results have been attained by the impregnation of armature and field coils with a recently discovered compound which upon being baked becomes hard and dense, like amber, and of great heat-resisting powers. Ordinary cotton insulation, so treated, may be heated above the ordinary charring point of cotton and yet retain nearly the full strength of the cotton. The basis of the compounds used for this purpose is the synthetic substance known as "bakelite." In the extensive experiments being conducted by one of the large manufacturers it is prepared in two forms, one a fluid, resembling shellac, and the other a thick paste. The former is used for painting and impregnating coils and the latter for filling interstices.

Experiments so far indicate that the safe working temperature of motors so treated is much higher than the present allowable melting point of the solder, and the motor applications approach limits of the melting of the solder in the commutator and mechanical strength of parts. There seems to be good reason for believing that treatment of armature and field coils with this substance will prove very valuable, both as a means of reducing the size of motors for a given duty and as a method of prolonging the life of motors already in service.

The use of field control holds out great promise of success. As the system is being worked out in practice the motors, of the ordinary interpole type, are provided with one additional field lead per motor. The control is so arranged as to provide one extra notch for high-speed running. When running on this notch part of the turns of the field winding are cut out of circuit, thus weakening the field and increasing the speed. This makes it possible to use a considerably greater gear reduction for the same maximum speed, provides three efficient running points instead of two, reduces the current used in acceleration, reduces the rheostat losses and the required size of the rheostats and, to some extent, increases the full-speed efficiency. These motors should considerably reduce the power consumption, irrespective of any reduction in the size of the motor, and in many cases they will permit of the use of a smaller and lighter motor. This will be true particularly in mixed city and interurban service, when frequent stops and high rates of acceleration in the city are combined with high maximum speeds on the interurban section.

SUMMARY

It would be by no means impossible to combine all five methods above discussed in one motor. The weight of the motors constitutes so large a part of the total weight of the electrical equipment that the motors seem to afford a more encouraging field for the lightening of cars than do the control apparatus and wiring. Nevertheless, the latter should not be overlooked. The manufacturers have made marked improvements in this field during the past few years.

Systems of multiple-unit control have been developed, both of the electro-pneumatic and the straight electric type, showing considerable reduction in weight. Platform controllers have been improved so that single car operation of the larger equipments is now practicable with controllers both lighter and much more reliable than were available a few years ago. The substitution of sheet metal for cast-iron end frames in resistance is another improvement worthy of mention in this list.

The heavy piping used in the modern system of all conduit car wiring is quite an item in the weight of the finished car. Several large roads have omitted most of the conduit in the wiring of their latest cars. It is claimed that the conduit wiring has not produced the expected degree of improvement in safety and reliability and has introduced some new troubles.

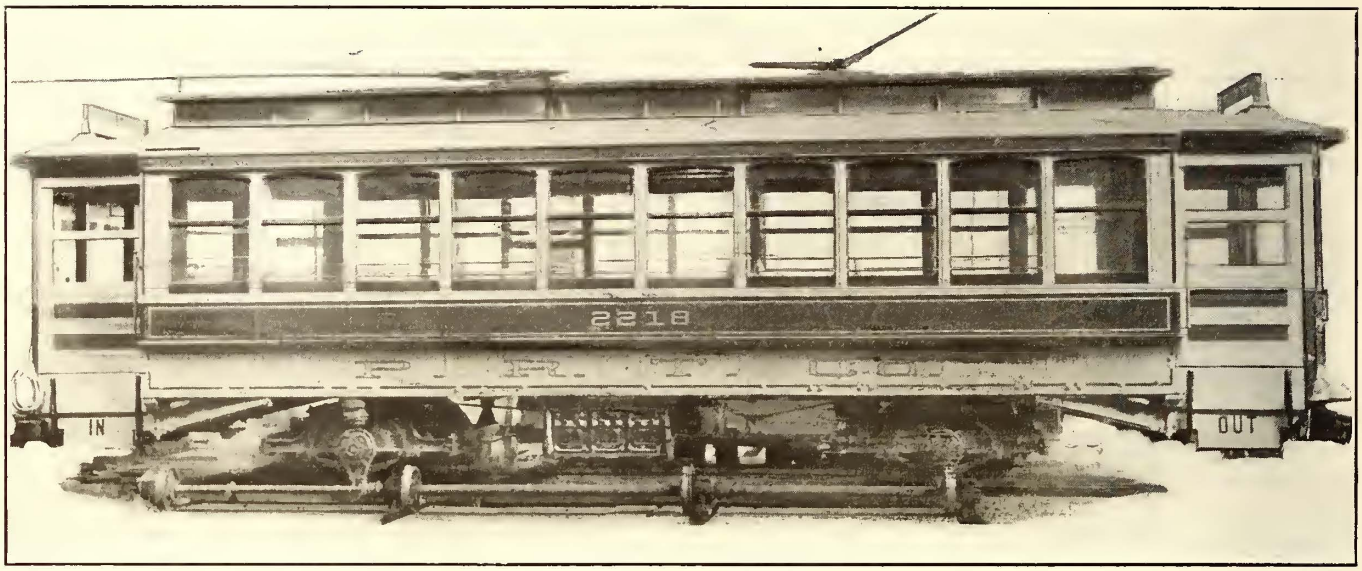


Fig. 11—Equipment—Philadelphia Car with Halsey Radial Truck

COASTING RECORDERS FOR CHICAGO AND BOSTON

The Chicago Railways, after an exhaustive trial test of eighteen months in which it equipped the fifty cars on the Van Buren Street line with coasting recorders, metered the substations which supplied current to this line and made observations as to the current saved, accidents reduced, reduction in brake shoe wear, changes in running time and operation of the clocks, has entered into a contract with the Railway Improvement Company, New York, for the complete equipment of all the surface cars on the system with coasting recorders to the number of about 1800. This contract was approved by the Board of Supervising Engineers Chicago Traction on October 5. These recorders will be of the new steel case, elapsed-time type which show the coasting time, car number and motorman's number. The tests which led to this contract were conducted under the personal supervision of John Z. Murphy, chief engineer of the Chicago Railways.

The Boston Elevated Railway has just concluded an investigation under Paul Winsor, chief engineer, of the Railway Improvement Company's coasting time recorders and has ordered their installation on the new Cambridge subway line and on all the elevated lines.

Engineering Association Question Box

Selected Questions and Answers from the Question Box Compiled by the Committee for Presentation Before the 1911 Convention at Atlantic City.

The preparation of the Question Box of the Engineering Association was assigned this year to a committee consisting of Norman Litchfield, Charles Rufus Harte and Rodney Hitt. This committee sent out a circular letter asking for questions to be submitted, and 124 questions relating to all branches of electric railway engineering practice were sent in by member companies and associate members. These questions were then sent out for answer, and replies to one or more questions were received from forty-nine company or associate members. The answers to each of the questions which are reprinted bear a key number corresponding to the following numbered list of names of those replying:

NUMERICAL INDEX OF MEMBERS ANSWERING QUESTIONS

1. Conestoga Traction Company, Lancaster, Pa.
2. E. P. Roundey, engineer maintenance of way, Syracuse Rapid Transit Railway, Syracuse, N. Y.
3. F. J. Foote, master mechanic, Ohio Electric Railway, Columbus, Ohio.
4. Thos. B. McMath, chief engineer, Indianapolis Traction & Terminal Company, Indianapolis, Ind.
5. Wm. Roberts, superintendent motive power, Northern Ohio Traction & Light Company, Akron, Ohio.
6. F. W. Sargent, chief engineer, American Brake Shoe & Foundry Company, Mahwah, N. J.
8. E. B. Lincoln, general manager, Muncie & Portland Traction Company, Portland, Ind.
9. F. B. Musser, president, Central Pennsylvania Traction Company, Harrisburg, Pa.
10. J. R. McFarlin, electrical engineer, Electric Service Supplies Company, Philadelphia, Pa.
11. F. D. Hain, superintendent construction, Altoona & Logan Valley Electric Railway, Altoona, Pa.
12. C. F. Hewitt, general superintendent, East St. Louis & Suburban Railway, East St. Louis, Ill.
13. E. J. Cook, vice-president, New York State Railways, Rochester, N. Y.
14. J. P. Barnes, electrical engineer, Syracuse Rapid Transit Railway, Syracuse, N. Y.
15. M. J. French, engineer maintenance of way, Utica & Mohawk Valley Railway, Utica, N. Y.
16. C. B. Voynow, assistant engineer of way, Philadelphia Rapid Transit Company, Philadelphia, Pa.
17. R. H. Hayward, general manager, Galesburg & Kewanee Electric Railway, Kewanee, Ill.
18. H. W. Fuller, general manager, Washington Railway & Electric Company, Washington, D. C.
19. W. G. Price, mechanical engineer, Standard Motor Truck Company, Newcastle, Pa.
20. Fred M. Daniels, chief engineer, Milford & Uxbridge Street Railway, Milford, Mass.
22. F. H. Miller, superintendent motive power, Louisville Railway, Louisville, Ky.
23. A. F. Hovey, cable engineer, Interborough Rapid Transit Company, New York, N. Y.
24. Westinghouse, Church, Kerr & Company, New York, N. Y.
25. W. J. Grambs, superintendent of light and power, The Seattle Electric Company, Seattle, Wash.
26. Geo. H. Harris, superintendent railway department, Birmingham Railway, Light & Power Company, Birmingham, Ala.
27. Wm. A. House, president, The United Railways & Electric Company, Baltimore, Md.
28. Norman Litchfield, engineer of car equipment, Interborough Rapid Transit Company, New York, N. Y.
31. G. H. Clifford, general manager, Northern Texas Traction Company, Fort Worth, Tex.
32. Chas. R. Sturdevant, American Steel & Wire Company, Worcester, Mass.
33. J. W. Hulme, general foreman, Hudson & Manhattan Railroad, Jersey City, N. J.
34. J. F. Calderwood, vice-president and general manager, Brooklyn Rapid Transit Company, Brooklyn, N. Y.
36. Richard McCulloch, assistant general manager, United Railways Company of St. Louis, St. Louis, Mo.
38. Albert B. Herrick, New York, N. Y.
41. C. T. Anderson, commercial engineer, Ohio Brass Company, Mansfield, Ohio.
42. Geo. M. Knox, general manager, Oklahoma Railway, Oklahoma City, Okla.
43. Washington Water Power Co., Spokane, Wash.
44. F. G. Grimshaw, master mechanic, Pennsylvania Railroad, Camden, N. J.
45. W. W. Wysor, chief engineer, Lehigh Valley Transit Company, Allentown, Pa.
46. W. Ogelvie, superintendent of overhead, British Columbia Electric Railway, Vancouver, B. C.
47. R. R. Kennedy, superintendent transmission, British Columbia Electric Railway, Vancouver, B. C.
48. F. M. Clouds, assistant superintendent, British Columbia Electric Railway, Vancouver, B. C.
49 H. Jackson Tippet, engineer maintenance of way, British Columbia Electric Railway, Vancouver, B. C.

POWER DISTRIBUTION.

2. *Is it wise to paint cross-arms without first specially drying out the sap and moisture?*

(1). To prevent dry rot, cross-arms should be thoroughly dried before painting.

(9). No, as the inclosed moisture and sap induces early rot.

(12). No, the paint would imprison the sap, which in turn would sour and decay the wood.

(18). It is our practice to paint cross-arms as we receive them from the manufacturer.

(22). It seems to be almost impossible to get seasoned lumber now: no doubt the painting prolongs life.

(24). It is better to have them dry. If you haven't the time to let them season, erect them without paint and paint them later. Prime the part that goes into the grain.

(26). Arms should be thoroughly dry before painting.

(27). Cross-arms should be free from sap and moisture when painted.

(44). From our experience we have found that where cross-arms have been painted when the wood has been green they have rotted out very quickly, and it is best to have the wood seasoned before painting.

7. *What method do you follow in pulling off curves? (a) With radius of 500 ft. or over? (b) With radius less than 500 ft.? What troubles, if any, have you experienced with this or other methods? What do you consider the special advantages of your method? What angle of bend do you allow at each ear? Do you offset the trolley wire from the track center line? If so, how much? How do you give the linemen this offset?*

(1). (a) We use single pull-offs from pole to trolley.
(b) Pull-offs bridled to backbone.
We experience no trouble with our method when poles are anchored.
Easy to keep curve in proper shape.
Whatever angle is required for each individual curve.
After track is finally tamped the linemen build in curve so wheel does not cut wire. Offset is usually about 6 in.

(5). Every 30 ft. on long curves. On short curves every 15 ft.
No trouble with curves.
Uniform support.
5 deg.
Yes; 3 in. to 1 in. in track elevation.

(9). Whenever possible, the poles are set in such a position that span wires can be run direct to the points of suspension. If local conditions do not permit the proper location of the poles a bridal construction is used. The angle at each ear averages from 5 to 8 deg. We offset the trolley wire from the center of the track, the amount of offset depending on the radius of the curve and also the amount of the track elevation. The linemen determine the proper offset by placing the trolley wheel of the line construction car at a point about midway between the ends of the curve and pulling the wire until the wheel sets parallel with the wire. The offset is then measured and the data thus secured are used in setting the hangers on either side of the center one. The last two or three hangers at each end of the curve are set to take up equally the remaining angle, the offset on these hangers being somewhat less than the center of the curve.

(11). Usually with sufficient pull-offs to cause wire to follow closely to track. On bracket construction with poles on outside of curve we run a backbone with sufficient intermediate pull-offs. With bracket poles on inside of curve set additional poles as required, unless additional poles outside cannot be set. We have 6-deg. curves with poles on either side set 75 ft. apart without intermediate pull-offs over which cars run 25 m.p.h. Also 11-deg. curves with poles and pull-offs on 50-ft. intervals over which cars run at same speeds. Curves that are sharp can be run more readily than easy curves, as the cars run more steadily and there is less likelihood of poles coming off. The angle allowed is gaged by the speed and wear, trying to get enough pull-offs so that the kick in the pole will not cause it to leave the wire and also to prevent undue drag on the wire. We offset the wire sufficiently to cause wheels to set tangent to wire. The offset in a vertical line from track on the longer radius curves, is mostly due to the elevation. We figure the offset due to elevation and add the necessary amount for the curve and give the linemen the result as a measure from one of the rails. With plumb line and rule the ears can be accurately located.

(12). Our method is a direct strain from pole, doing away with what is termed a bow string or backbone arrangement. For a radius of 500 ft. or over we set poles at approximately 80 ft. Less than 500 ft. radius we use our standard spacing of 100 ft. With this method we have reduced our trouble to general wear. The objection to the backbone arrangement is that should one rib break there would be a corresponding slackening of all the other ribs in that backbone. Another point is that with so much wire under tension there is bound to be a continual slackening of the trolley wire. The special advantage of the direct-pull arrangement is that of accessibility in making repairs, as the break will either be at the pole or at the trolley wire, and can be repaired from a line car, whereas in the backbone construction it would be necessary to provide a ladder to renew a rib, as the work would have to be done midway between poles and away from the track. We offset the trolley wire from center of track from 2 in. to 20 in., depending on elevation of rail, position of trolley stand and height of car. We have no definite rule for this but are governed by the position of the trolley wheel, which we plumb from the height of the trolley wire to the track.

(13). Pull-offs are placed on curves from 5 to 10 ft., depending on radius. We offset the trolley wire from the track center line, but it depends entirely upon the radius of curves and the position of the trolley pole on the car and the height of trolley wire from the track. This also depends on the track elevation. Linemen are not given any rule, but use their judgment in placing wire.

(22). (a) 500 ft. or over, pole spacing 75 to 100 ft., one or more pull-offs from main strain.
(b) Less than 500 ft., poles spaced 50 ft., one or more pull-offs from main strain.
(c) Very little trouble when trolley is pulled taut.
(d) Simplicity.
(e) Trolley wheel must take bend easily, and without undue wear.
(f) Yes, depending upon elevation, offset from center equals height divided by gage times inches of elevation.

(24). (a) Poles should be set about 80 ft. apart. Two pull-offs in each section. If the curve is a long one, it could be done with a light backbone wire and running square to the pull-off.
(b) Depends on conditions. Generally use two bull rings to each curve. Never allow over 10 deg. bend at any ear. Always offset the trolley wire from 1 ft. to 18 in., depending on the curve and also the elevation.

(25). We have no fixed angle of bend which we allow for the ear. We do offset the trolley wire from track center on curves. The amount of this offset is left to the judgment of the trolley line foreman.

(26). (a) Pull-off in 20 deg. curve, approximate distance, 7 ft.
(b) 8 deg. curve, 20 ft.
(d) None outside usual wear and tear.
(e) We have used no other method.
(f) About 2 in.
(g) From center of track 12 in. back to center of track. This depends upon the ballast of the track.

(27). (a) and (b) We use the pull-off method and also double lacing between poles.
(c) No particular trouble has been experienced with this method.
(d) Easily maintained and kept in line.
(e) We have adopted no rule governing this, but depend upon the line crew foreman in charge of work using proper judgment.
(f) The trolley wire is offset from the track center line, the amount depending on radius of curve and size of car which is to be operated over same. This offset is best determined on the ground.

(46). (a) We run a back-bone with pull-off in the middle of each span.
(b) We use the same construction with more poles and pull-offs but find that the less attachments to the wire, consistent with a good curve, the better.

8. *How often do you anchor the trolley wire? What method do you use? Do you avoid tipping up the ear by this method?*

(1). Every tenth pole on bracket construction. We use anchor ears and anchor. Yes.

(5). Do not anchor. Depend on upkeep of suspension.

(9). Every ¼ mile on a straight line, a four-wire swivel strain yoke anchored to four poles being used. The line is also anchored at each end of all curves, a two-wire double curve suspension being used. This method is the best we have found yet, but it is not altogether satisfactory.

(11). Every half-mile with soldered strain ears and double guys each way giving four anchors. On double track, run a strap between ears at both ends and single guys each way. This keeps the ears in proper position.

(12). Every half mile. We use a Metropolitan strain pan made up into the regular span wire and anchored to poles pulling from the four corners of the pan, poles are in turn guyed to succeeding poles in line; this is for single trolley; for double trolley the same general scheme is followed with the exception that pans are guyed to each other. In fastening guys to poles we raise the guy about 2 ft. above the regular span make-up to allow for the greater distance from pole to trolley; this prevents throwing additional weight on span wire supporting strain pans. We have experienced no tipping up of ears.

(13). Trolley wire is anchored about once every ½ mile. The strain plates are of our own design and are used in connection with double-end pull-offs which prevent the ears from tipping due to the uneven strain of either the adjacent sections of trolley wire or the pull of strain wires.

(22). Once per mile. Strain plates bolted to ear, guyed in four directions. Yes.

(24). Anchor every ¼ of a mile on interurban roads. Also anchor at the curves. If anchor guys are properly applied, will have no trouble with the ear tipping.

(25). We do not anchor the trolley wire.

(26). Every 1500 ft. on a straight line. On curve work strain plate at each end of curve.

(27). The trolley wire is anchored at the ends of all curves, and every 3000 ft. on straight line. Anchor ears with swivel is the method used. Very little trouble is experienced by ears tipping.

(46). In city work we anchor all curves in all directions, so that they are independent of the straight wires. We also anchor straight wires at all splices and section insulators. In interurban work we sectionalize trolley wire every 6 miles and also anchor the lines at intervals of about 3500 ft., or at every splice. The method of attaching anchors is by running a second span wire over the trolley span and anchoring both ways vertically over the wire. This leaves nothing for the wheel to catch in, if it should leave the wire. In the case of bracket construction a similar method is pursued, fastening the anchor cable to the bracket arm above the trolley ear. We have found this construction uniformly successful.

15. *Have you experienced trouble with round-top hangers and ears failing to square up when screwed together? If so, how do you obviate this?*

(1). Yes. We obviate this by the use of leather washers.

(5). Some. Push up with extra leather washer.

(9). Yes. Have no remedy as yet.

(11). They scarcely ever square up. We give a liberal dose of machine oil inside the ear before screwing up and very rarely have any trouble from rusted ears. In localities where rusting effects are bad it would be better to use a regular joint compound as it is less likely to dry out. As long as threads are protected from rusting we do not think it very important to have them square up.

(12). Have experienced trouble by failure of hanger to tighten on ear causing a loose fit in thread and in time cutting thread smooth in ear, allowing it to become detached from hanger.

(13). We have very little trouble. If the ear does not turn completely around on the hanger, it is unscrewed and oftentimes a spring washer placed between the ear and the hanger stud.

(24). Very often have this trouble. Sheet lead washers will remedy the trouble.

(27). We do not use round top hangers for the reason that they do not square up.

(31). Yes. To obviate the trouble we buy our hangers with studs ½ in. longer than standard and place a spring washer between the hanger and the ear.

(41). We, as manufacturers of overhead materials, find that there is a growing demand for a hanger or an ear which will permit the two being tightly fastened together when they are in proper alignment. It would not be necessary to use the Tightlock ear with the Tightlock hanger, but rather the Tightlock ear with the ordinary hanger or vice versa. The scheme is in effect a strong lock washer between the ear and the hanger. If placed on the ear the boss is machined to the proper shape and a metal cap is swaged over the tapered portion of the boss to retain the washer in place before installation. If the lock washer is applied to the hanger the stud is made in two pieces, the lower portion being free to move up and down vertically within the cup casting. Both of these devices have been found practical and efficient.

28. *To what amount do you limit the total drop in voltage per mile in the negative return system?*

(5). This ought never to be as great as the copper drop. If it is, it is due to neglect of bonding.

(13). Five volts per mile.

(22). Ten volts per mile.

(23). Average total drop would depend largely on distance between substations and condition of track and amount of traffic. On sections one mile long for two track sections 13 volts, for four tracks 12 volts, per mile where substations are 2½ miles apart.

(26). Five per cent in entire line.

(27). We use only sufficient return to prevent positive conditions in water and gas mains adjacent to our system. When this condition is attained and the returns do not heat up, we consider that we have sufficient negative return.

(38). This question involves the cost in dollars of the loss in the ground return circuit. Consequently the cost of the energy frittered away in this circuit and at what rate this energy must be charged has to be fixed in each individual case. However, it should be borne in mind that the cost of current production for this superimposed load, to make up for these losses, should not be taken at the same rate per kw-hour as the unit cost for the total station output. This additional load can be produced at a much lower rate than the station rate, because it does not carry any of the fixed charges. Where the cost of this additional load is not known, it is the usual practice to take it at a value of one-half of the station cost. The losses in the return circuit increase with the square of the current value. Hence, the average we take must not be the average of the circuit values on the return circuit, but the mean average of the square value of the current delivered to the section of track in question. When the product of the average resistance and the mean square current value found over this section of track back to the power station is multiplied by the time in hours per annum during which the current is conducted through this circuit, the product will be the lost energy, which multiplied by this energy cost will give the cost of energy loss from the point of test to the negative bus. (The method of discovering these potential drops and current values is given in answer of No. 38 to question 29.) The actual money saved by increasing the conductivity of the return circuit will be the difference in the cost of the energy lost in the present and the improved return circuits added to the interest and amortization of the cost of the improvement. The amount of money that will yield a profitable return on this improvement will be approximately fifteen times the cost of the losses between the improved and original return circuits. It will be seen that several calculations will have to be made in each consideration in order to arrive at the investment which will return an interest of 6 per cent; therefore it is impossible to state a fixed allowable voltage drop over any track return without knowing the cost of this loss, which varies with the square of the density on the rail and resistance of the circuit. The problem cannot be reduced to an empirical form, as each case has to have an individual solution on account of the variables involved. In the case where an additional car has to be put in service to maintain the headway, due to reduced speed in miles per hour arising from excessive return drop, the problem must be solved as follows: The cost per car mile of the additional mileage made by this car, multiplied by the number of miles this car makes per annum, multiplied by fifteen, will give the permissible investment that would approximately earn 6 per cent on the additional cost for increasing the conductivity of the track return. Of course, this is not all the profit involved in the improvement, for when we have a higher voltage delivered to the motor brushes the average equipment temperature will be reduced, the secondary effect being in the reduction of cost of electrical maintenance. Again, as the natural earth return is in multiple with the artificial rail return, any increase in drop on the rail circuit will divert more current from the track. Furthermore, if the track parallels any conducting pipe lines, this diverted current will take the pipe path back to the power station. Any neglect in the circuit from this point of view will produce a hazard, and careful engineering requires special attention along this line, as neglect leads to a direct liability for damage due to the action of electrolysis.

(42). Five volts.

(43). Twenty-five volts irrespective of distance.

29. *What is the best way to test the total drop in voltage of the negative return system between two points on the track or between a point on the track and the power house?*

(5). With adjustable resistance on car.

(13). Tests that we have made to determine the drop between a certain piece of track and the power house have been made by using a telephone circuit or an auxiliary feeder.

(17). The best way of testing the drop in the return circuit is that followed by us several years ago. We made the test during the hours of no car service, by short circuiting the trolley on the rail and then throttling the steam pressure, and adjusting the field excitation of one of the main units at the power house until a value of current and voltage was obtained that could be read with reasonable accuracy on the station instruments. The volts divided by the amperes gave the total ohms resistance in overhead and return, from which the resistance of the return was obtained by deducting the resistance of the overhead, figuring it from the known length and cross section of the conductors.

(20). I have always used the wires of the telephone despatching system for potential wire to test rail drop either between points on the track or to negative bus at power station. By simply grounding the line to the rail at one end and reading the voltage at the other end the result is very readily accomplished. If telephone wires are not available, any other wire that can be spared for a few minutes can be used in the same way.

(22). A voltmeter between a negative potential test wire free from all stray currents, grounded on one end, station end, and the rail.

(23). Use telephone wire or run temporarily insulated copper wires between the two points.

(25). We use telephone wire for pressure wires. When we have no telephone lines, we run No. 18 weather-proof wire out from a reel and hang it on pole steps.

(27). Voltmeter and potential line.

(36). The best method is the use of a pressure wire in connection with a recording voltmeter. This voltage may then be taken either from the negative bus bar to any part of the track, or between any two parts of the track.

(38). Steel rails, with bonded or welded joints, in parallel with earth, underground metallic structures, and auxiliary copper form the conducting path. In elevated roads, the rails may be largely insulated from the structure and if so form a special case. The resistance of the return circuit is not a constant quantity. It is, of course, desirable to arrive at a mean value which closely approximates the resistance under the average operating conditions. The variable factors include ground moisture, associated with the length of time the current has been flowing from a rail into the earth, defective bonded or welded joints associated with the time of day or night; and the weather, including temperature fluctuations, rain, or frost in the ground. A rail delivering current into moist earth has a tendency to insulate itself from the earth. The action of the current repels the water from the rail, thus drying the soil and raising the resistance through the earth. A continuous current flow of a few hours will produce a marked change in the earth resistance. A measurement taken during the night will not give the same results as one taken during the day, due to this change in the current flow. A defective bonded joint will not have the same resistance in the early morning that it has in the later afternoon. During the hours of the night a light film of oxide will form upon the more or less imperfect contact surfaces at the joint, and during the day this film is broken down, both by the mechanical action of the car wheels passing over the joint and by passage of the return current through the joint. An extreme case has been noted where the first car out on the line in the morning had difficulty in moving at all, because of low voltage due to this cause. If the measurements are to be made at night this trouble may be overcome by placing a rheostat beyond the point of test, and allowing a current of say 100 amp to flow continuously through the rails. The temperature coefficients of the conductors will ordinarily be negligible, but the earth resistance due to variation in rainfall, drainage or frost in the ground, is highly fluctuating at different times. Frost and good drainage produce a high resistance, wet ground low resistance. As to the method of making the tests: A pressure wire between the two test points is essential. Any unused feeder or any other conductor may be used. The most convenient pressure wire available will be found in the telephone system. It is possible to pick up a telephone line at almost any point of a railway system at present. It is not necessary to remove such a line from telephonic service for more than five minutes for the test, but suitable preparations must be made beforehand. All foreign currents or potentials must be removed from the pressure wires. This is done at the exchange by simply removing the heat coils on the main frame. At the power station a jumper from the negative bus is made ready to clip on the telephone line and at the exchange another jumper is ready. Both sides of the line are used in multiple to reduce the line resistance. The men on the track, in the exchange and at the power station will all be in communication by telephone just before the test is to be made and it is hut a few seconds' work to attach the jumpers and remove the heat coils in the exchange. The voltmeter may be anywhere in the circuit, at the track, in the exchange or at the power station. Since the voltage varies with the traffic loads, it is best to take instrument readings for two or three minutes in order to secure a fair average. At any time all three parties may re-establish telephonic communication by cutting in on the line with telephone test sets, using the earth potential as battery, with the earth forming one side of the line. When the test is completed the jumpers are removed and the heat coils replaced, after which the lines are all in service as before. As stated previously, good operators will not take more than five minutes for a test. It will be noted that the voltmeter reading obtained will not be the true voltage between the test point on the track and the negative bus, due to the potential drop in the pressure wire. To eliminate this error, two readings must be taken as nearly simultaneous as possible, using two different scales in the voltmeter. Thus two different voltmeter resistances will be inserted in the line and the true voltage may be quickly calculated by a simple formula. By this easy method track drops may be obtained over a very large system with great facility. If a large number of tests are to be made, it is possible for two men to do all the work, if a spare wire can be run to the negative bus at the power station. Tests made between any two points on a track may be made in exactly the same way. Inasmuch as the telephone companies are highly desirous of having these tests made, because of the electrolysis situation, they are generally very ready to lend the use of their lines.

(42). Use telephone line.

(43). We use one of our series arc circuits and by grounding it at the power house we measure the drop with a voltmeter.

32. *What is best method of inspecting lightning arresters that have no moving parts?*

(1). Examine each arrester thoroughly and see that no part is damaged.

(10). The only practical manner in which to inspect arresters having no moving parts, particularly if the arresters are pole arresters, consists in giving the arresters a very careful visual examination. Especially is this true if we consider that a lineman is the man upon whom such work as this is bound to fall.

(12). For series gap, test each gap or layer individually (this test is for leakage); to make test for ground we jump around the arrester with a lamp circuit.

(13). Arresters of the type made by the Westinghouse Company we do not test, otherwise than the ground connections. Arresters such as the G. E. type are tested by means of tin-foil inserted in the spark gap.

(22). Carefully inspect all connections, and if there is any air gap; keep free from dust; test for open circuit.

(26). Lightning arresters are tested three times a year. Ground wire is tested for 15 amp and arresters that have movable parts are short circuited to see if coils are closed and in good condition.

(27). Open case to see if proper gap exists.

(42). Paper slips inserted between points in gap.

(43). By taking them apart.

(47). In electrolytic arresters by carefully noting the condition of the charge, and if necessary by removing the nest of trays and making a thorough inspection of each tray for punctures and blisters. On multigap arresters by noting the condition of the blocks and keeping the units free from dust.

33. *What do you consider the best way to ground lightning arresters? Why? Is it desirable to ground pole line arresters to rail as well as to earth?*

(1). We ground pole line arresters to rail and earth, as it gives a better ground.

(8). To ground and rail. Ground should be made with galvanized iron pipe, put down 6 or 8 ft. deep.

(9). Our present method of grounding lightning arresters is to drive a ¾-in. galvanized pipe, 14 ft. long, into the ground to a depth of 6 ft. On top of pipe a brass cap is fitted. This cap has a lug to receive the ground wire from the arrester. About 6 in. below the ground line a tee is fitted to the pipe, and at this point a branch pipe is run to the track and there soldered to a cross bond. The pipe construction is preferred to a wire construction, as it best resists the corrosive action of electrolysis, and also the pipe is not so likely to be tampered with by outside persons. On open track set up on ballast we think the arrester should be connected to the rail as well as to the ground.

(10). The best method to ground lightning arresters is bound to vary in different localities. What is a good ground and an economical ground in one place may be a poor ground and an expensive ground in another place. Station arresters are, as a general rule, grounded to a permanent and well-made ground which is made and maintained at the station. This class of ground is usually made from a large and heavy metallic plate placed in the soil deep enough to always be in contact with permanent moisture. This class of ground is very efficient usually, but the use of a ground even approximating this on the pole line is barred usually on account of the excessive cost. We consider the best and most economical ground for pole line work to he that obtained by the use of iron pipe driven into the earth. The iron pipe ground possesses the advantages of efficiency, durability and economy in a marked degree. It is a cheap ground; it is easy to install; in most soils a pipe driven to a depth of say 8 ft. makes an efficient ground, and in case the conductivity of a single pipe in any particular soil is low, it is an easy matter to drive an additional pipe or pipes, and by connecting them all in parallel to get the required conductivity from the multiple ground. The time required to install a pipe ground and to connect the arrester thereto is very small, thus making the matter of installation of these grounds an easy one and a cheap one from a financial standpoint. And withal, the pipe ground is very durable. Pure iron pipe placed in the soil has a life many times greater than that ohtained by other grounding methods, notahly copper plates huried in the earth. Pole arresters should by all means be grounded to the rail as well as to the earth. The most important reason for connecting the arrester to the rail as well as to the earth is to eliminate the possibility of an induced charge collecting on the rails and discharging through the car apparatus at the same time the pole arrester discharged. This rail induced discharge becomes especially prevalent on roads on which the rails are laid on rock ballast and so are practically insulated from earth for considerable distances; the extra connection from the arrester ground to the rail serves to equalize the potential between the rail and earth at the time the pole arrester discharges, thus eliminating any tendency for the rails to discharge through the car apparatus. A second reason why arresters should be connected to the rail is owing to the fact that standard types of railway arresters require a certain amount of line current for their operation. Without the rail connection the ground resistance in many instances becomes so high that the flow of line current following the discharge to ground is just too small to operate the circuit opening device, so allowing the arc to maintain and the arrester to be destroyed. The one possible disadvantage resulting from connecting arresters to the rail as well as to the ground may be classed under the head of electrolysis. The trouble experienced from this source is, however, so small compared with the advantages to be secured by so doing that it is negligible in comparison.

(12). Dig hole 2 ft. square and 8 ft. deep. Put in layer of charcoal 6 to 8 in. deep, put ground plate of copper 2 ft. square, No. 16 gage on top of charcoal, and have wires from arrester soldered securely to ground plate. Cover ground plate with charcoal or coke to a depth of 6 in. Wherever possible ground to rail, providing the rail has good and permanent earth contact at place where connection is to be made. This serves two purposes—first, it gives more ground surface to carry away the discharge; second, should the wire become disconnected from ground plate there would still be ground at rail.

(13). In connection with the installation of pole line arresters we believe that a pipe 10 ft. long, driven into the soil, is a sufficient ground and would strongly recommend the grounding of the arresters to the rail as well as to the pipe.

(20). Grounding arresters of the type that use magnetic blowout to the rail has cured many of the burnouts that we formerly had. The trouble was apparently caused by insufficient current flowing to operate the blowout and setting the arrester on fire and destroying it. Other types I believe will give more efficient results though not requiring the rail ground for the same reason. The ground to earth we accomplish in a variety of ways, according to the location.

(22). Connect to rail, either by rail bond or soldering to base of rail also to rod, ⅝ in. or ¾ in. by 8 ft. long, driven into earth. The best ground possible is none too good.

(26). Bonding to rail. We have not been able to secure good results by grounding to earth.

(27). Where the earth is comparatively dry, ½-in. galvanized iron pipe driven in the ground at least 10 ft. makes best ground. Where earth is moist, copper plate buried in charcoal makes best ground. It is desirable to connect arresters to rail as well as ground on suburban lines.

(38). A lightning arrester should not be grounded on the rail. There are two effects of this connection which may render the arrester useless. Suppose the arrester to be grounded to the rail without auxiliary ground plates. The enormously high frequency of the lightning discharge together with the inductance of the rail renders this ground connection a very poor one. In the case where ground plates are used in multiple with the rail it is a probable condition that traffic current will pass over from the rail to the ground plate and then into the ground. The action of this current will be to insulate the ground plate from the earth or to destroy it altogether by electrolytic corrosion. A ground plate should always be located so that it is absolutely free from all stray currents.

(43). By the use of a flat strip connecting them to the best ground available.

(47). Use a separate ground for each as this will eliminate trouble which may arise from connecting a number of them to a common ground. We do not use pole-type arresters, but our indoor type is grounded to rail.

34. *What experience has been had with electrolytic lightning arresters for 600 volt d.c. service?*

(5). Splendid.

(13). (b) We have only used two aluminum cell-type arresters in connection with our cars and have installed one on the line. The line arrester was up two weeks and burned out.

(17). We have great confidence in the efficiency of the electrolytic, or tank, arrester for 600 volt, d.c. service. In 1907, immediately after we commenced operating our interurban line from our 600 volt d.c. power house, one lightning storm knocked out the generator in service then, and another storm soon after knocked out the other generator. Our system at that time was protected by the ordinary types of arrester installed in the power station and on poles and cars. This serious damage from lightning convinced us that more protection was needed, so we installed a tank arrester in the basement of our power house, and since 1907 no trouble whatever has been experienced from lightning at our plant. The loss of several motor armatures during severe storms last year led us to install last spring another tank arrester at our office building, near the center of our city overhead, and thus far this season no car motors have been damaged.

(22). Very good on indoor work; no experience with car or outdoor service.

(47). We have two sets of electrolytic arresters on the d.c. side of two 2000-kw, 60-cycle rotary converters, but have no record of their ever having discharged.

37. *What routine tests should be made (and how often) to determine condition of rail bonding? (a) In city service? (b) Interurban service?*

(1). As often as possible everywhere.

(5). Continual sectional tests.

(8). Every three months and oftener if possible.

(9). (a) Once a year for city service. (b) Twice a year, spring and fall, for interurban.

(11). We use an autographic test car and results show that yearly is not too often.

(13). (a) In city service where bonds are installed on the web of the rail a test once each year we consider sufficient. (b) In interurban service where bonds are installed on the ball of the rail no test is made as an inspection will show what bonds are off. Where bonds are concealed on interurban service they should be tested once every two years.

(17). Every spring each different line of track, city or interurban, on the system should be tested by selecting what per cent of the joints in that section were of higher resistance than standard. From this preliminary test would be decided the question whether conditions were bad enough to require that the entire line be tested and repaired.

(18). We believe all bonds should he tested once a year, preferably in the spring, and all defective bonds replaced. This would apply to both city and suburban service.

(22). (a) Regular inspection and tests, say, once a year. (b) Once in two years.

(23). (a) Once a year. (b) Once a year.

(25). (a) In city service, we try to test the bonds once a year.

(27). Where service is light and track structures heavy and substantial, once a year might be sufficient; while other conditions might require monthly tests. This applies to city as well as interurban lines.

(32). (a) In that portion of city track work where the current density is heavy, especially in portions near the power house, it would seem advisable to test the track either as a whole or by means of some bond tester at least once in three months, or oftener if there is any indication whatever of poor joints. This is not only to prevent heavy losses in poor joints, but also to prevent electrolytic troubles which might be developed in adjoining pipe lines. In large cities where the traffic is very dense, and where the current density in the rails would be excessive, it would seem advisable to have a competent representative testing and inspecting rail joints continuously. (b) The ordinary interurban roads should be tested for poor joints at least twice a year—in the fall and in the spring.

(36). (a) The joints in city service are tested with a portable bond tester. The most important portions of the track are tested about once a year. (b) On interurban service an inspection of the joints is made at least once a year.

(42). Twice a year, city; once a year, interurban.

(43). We do not make any routine tests such as outlined.

(44). We test our bonds about every six months.

(46). (a) All bonds should be tested electrically every three months. (b) We carefully inspect them, regularly, particularly the soldered type.

WAY MATTERS.

44. *To what extent have you practised joint grinding on old tracks? What is cost per joint, and what increase in life do you estimate will be obtained therefrom?*

(1). We replace splices when worn and do no grinding.

(2). We have been grinding joints in old track practically continually for the past two years. Costs from 25 to 75 cents per joint. Increased life depends on age of track and traffic. We believe that the saving on wear and tear of equipment and reduction of noise and jar to adjoining buildings is of as much importance as the increased life of rail and pavement at the joints. Badly pounding joints will ruin the best of pavements in a short time.

(4). We have used Atlas step joints on worn joints, grinding the joint to make it smooth.

(5). Grind with portable electric and hand grinder.

(9). Within the last year we have started to grind the joints in old track. The cost per joint varies with the condition of the old track, being from 50 to 75 cents per joint. We estimate that we get about two years additional life of the rail.

(11). We have ground possibly 100 joints and the cost ranged from 15 cents to perhaps $2, depending on amount of wear to be taken care of and how much we dodged the cars. We use a block of carborundum 2⅜ in. square and 12 in. long, set in a cast iron block with handles. The block, which was made larger than necessary to hold the carborundum, in order to give weight to the stone, weighs about 90 lb. The handles are hinged on so that block will run level. We expect 25 to 50 per cent increase life to rails. On very bad joints we cut out the joint and shift the rails.

(13). For the last two years we have followed the practice of filing all our joints with a heavy 3-in. file. It has cost us about 28 cents a joint to do this work. Cannot give the estimated increase in life of such work.

(15). We have ground, between June 28 and Aug. 10, 673 joints on Lorain Company section 95-297 rail, at an average cost of 59.95 cents per joint. The track on one line would have required renewal in 1912; I estimate that it will now last until the Fall of 1913 and regrinding may prolong the life until the Spring of 1915.

(16). When joints in old track are already pounded, the joint plates are also affected, the receiving half of the plate being also cut, and mere joint grinding will give very temporary relief as there is no support left for the receiving head. The cost of grinding depends upon the condition of the joints—from a few cents to 50 and more.

(42). Cost $1.25 per joint. Increase life of rail 30 to 40 per cent.

46. *With best type of track construction, should asphalt or any other type of sheet paving be used on streets where street railway tracks exist? If not, what is the best type of pavement, and why?*

(1). Not within 3 ft. of rails, which should be blocked.

(2). Sheet paving should not be used. Stone or wood block wears better, can be used over again and repaired by company's forces. In our climate asphalt cannot be repaired in the winter.

(4). Do not use asphalt, use cut granite blocks next to the rail on both sides of each rail, then pave with granite or brick. Reasons: (1) Vibration of the rail will loosen the asphalt from the base, admit water and destroy the sheet paving adjoining the rail. (2) Repairs to sheet pavement can only be done by a party with the proper plant. Brick and block repairs can be done with labor that can readily be employed.

(5). Use brick on account of flexibility.

(9). From the standpoint of durability, wood blocks would be the most desirable.

(11). The shear of wagon wheels and vibration in rails will soon cause any sheet paving material to disintegrate.

(12). Asphalt should not be used as ruts will soon cut in beside rail. Brick, granite or wood block make good paving for tracks, depending on class of vehicular traffic. They can be repaired without an elaborate repair outfit.

(13). We do not believe that sheet asphalt should be used in connection with paving steel railway tracks on account of the fact that it cannot be maintained next to the rail. We are having best success with the stone block pavement on account of the fact that it is easier to maintain adjacent to the head of the rail.

(15). No monolithic pavement will last as well as pavement composed of separate blocks of material, such as granite, sandstone, vitrified brick, asphalt block or ceosoted wood.

(16). In heavily traveled streets granite block paving between rails and one or two rows of blocks outside the rails would give most economical results on account of concentrated wear by teams and cheaper repaving in case of track repairs. The shoulders may be made of sheet paving.

(18). For the best type of track construction we do not believe asphalt is the proper pavement. On streets where heavy vehicular traffic exists we deem scoria block, granite block or wood block the proper pavement. There is no salvage after asphalt pavement becomes worn or decayed. With any of the other types the pavement can be taken up and possibly the blocks turned over and repaved.

(36). In asphalt paved streets the asphalt should not be allowed to come in contact with the rail. A toothing either of granite blocks or brick should be placed on each side of the rail.

(42). Brick on account of lasting qualities.

(45). I do not approve of sheet paving on track area on account of the difficulty of repairs which generally have to be made by the company laying the pavement and it is hard to get them to attend to small repairs promptly. Some form of block pavement I think is preferable.

(49). Where the type of track construction has a solid concrete slab foundation on which the track is laid there should be no fear of disturbing a sheet asphalt or other surface, but it is not recommended to lay asphalt right alongside the rails. The best material in this case appears to be granite blocks to a width of some 12 in. each side of the rail. Trouble is experienced here where the use of treated or more particularly untreated wood block is used on streets where tracks exist—due to considerable lateral pressures from the wood blocks, tending to push the rails out of line. This trouble is not experienced with other pavements.

50. *What is the best method of protecting webs and bases of rails in paved streets against corrosion?*

(1). Good bonding and absence of cinder or ashes.

(4). Use enough filler (asphaltic or cement grout).

(5). Cement grout.

(9). Have not been troubled with corrosion of the rails to any extent, although we have not taken any special precaution to prevent it except maintaining the bonding in good condition.

(13). We make no effort to protect rail against corrosion.

(15). Bond to full capacity of rail section.

(16). Packing with concrete against the web and around the foot of rail will protect the rail from oxidation to a very great extent.

(18). We have no appreciable trouble with corrosion of webs and bases of rails in paved streets.

(42). Cement filler blocking.

(45). We have not attempted any kind of protection.

(49). Have not considered the neccssity of protecting webs and bases of rails against corrosion. Have found on removing old permament track webs were in fair condition but bases worn sharp on ties.

55. *Should outer rails in curves on city streets be elevated above inner rails? If so, how much as a maximum?*

(1). If possible, yes. Usually 3 in.

(4). If conditions permit elevating the rail do so. On paved streets very little elevation can be given. The amount depends on the contour of the cross section of the street.

(5). Yes. 2 in. maximum.

(9). From the standpoint of track construction the outer rail should be elevated, but from the standpoint of street construction it should not be. We have them elevated as much as 3 in.

(11). This is dependent on whether stops are made or not. We find that 5 in. is about as high as is desirable and that 3 to 4 in. will usually allow equal wear to rails. The crown of street paving will frequently determine the amount.

(12). Yes, if any speed is desired. Paving will rarely permit more than 2 in.

(13). We elevate the outside rail on all our curves in city service, both inside and outside curves. 2 in. is the maximum.

(16). The outer rail should be elevated. This gives more life to the curve and greater safety. Depending upon location and speed, even as high as 5 in. at the central radius of spiral, if spirals are used. The elevation should be gradual, starting at some distance on the tangent.

(18). We believe that outer rails on curves in city streets should be elevated above inner rails a maximum of 1½ in. on curves of 35-ft. radius. This elevation, however is often determined by the grade of the street or municipal regulations.

(36). Outer rails in curves should be elevated above inner rails as much as the width of the street and the nature of the paving will allow. In wide streets as much as 2-in. elevation may be obtained.

(42). Yes. 1¼ in.

(45). By all means where contour of street will permit or where city authorities will allow distortion of street surface. I do not recall a case where there was any danger of getting too much elevation on paved street, but believe 5 in. maximum sufficient for all ordinary needs.

(49). Outer rails need only be elevated where there is a grade which will render it difficult for cars to easily round the curve. In one instance we have an elevation of 2½ in.

57. *What is the best type of foundation for special work, particularly at intersections?*

(1). Heavy chestnut timber, well tamped. Have some in now 18 years and still sound.

(2). Concrete or crushed stone, grouted.

(4). A sub-base of Portland cement concrete to 2 in. below the ties, use full number of ties and tamp up work with concrete with very little water (so dry it will not slush up at all), then concrete for paving base and pave.

(5). Concrete with limestone surfacer.

(12). Well tamped macadam, well drained.

(13). Stone ballast.

(15). Concrete foundation is best for complicated special work. Use wooden ties and concrete to paving sub-surface. For plain curves steel ties in concrete are preferred.

(18). Concrete.

(36). All special work should be laid on oak ties, imbedded in concrete, the concrete extending at least 6 in. beneath the ties.

(42). Crushed lime stone.

(45). We use crushed stone but where sub-foundation is bad it is better to use concrete. It is essential, however, to suspend traffic until concrete is set.

(49). While the method of contruction depends somewhat on whether the special work junction is to be laid under traffic or not, we would prefer a slab of 6 to 8 in. of concrete under the ties, which we space 24 in. center to center.

69. *To what extent can oil be used instead of water to sprinkle unpaved tracks? Best apparatus for applying? Quantity necessary per mile of single track to last for entire season?*

(8). We use oil. Sprinkling wagon. Do not know.

(18). We believe that oil can be used to the full extent instead of water for unpaved tracks. By unpaved tracks we understand macadam is included. The best apparatus for applying would be an ordinary sprinkler car, and from information as to cost of oiling streets a strip 9 ft. wide would cost $2,346 per year. This is based on 5 cents per sq. yd. per year.

(45). We have used 40 per cent asphalt road oil the past two seasons. About one-half gallon per sq. yd. is required and three applications during the season to keep the dust down. The second and third applications do not require so much oil as the first. It has generally been applied to track area by city or township which oils balance of street. Old water wagons with suitable appliances for distributing oil make good apparatus. It is hard to keep oil off the rails and it is necessary to keep man with sand can along with oil tank.

POWER GENERATION.

76. *What is the best method of eliminating dust from the air intake where the air is to be used for cooling generators, and transformer winding?*

(1). We keep the ground surrounding our plant thoroughly oiled.

(5). Take the air from a place practically free from dust.

(22). Filtering air through first metal, and then cloth screens.

(25). We use no special apparatus for removing dust from air intakes. The intake pipe is turned downward and covered with a screen of ⅛ in. wire mesh, leaving the end of the intake about 8 ft. above the ground. The lack of dust in this section makes other apparatus unnecessary.

(26). By screening and running through a water spray.

(27). Where the room is available and the amount of dust warrants the cost, a large screen chamber may be constructed, this room to be divided into two large compartments, each fitted with screens having varying size openings and deflection plates onto which are fitted ribs to act as dirt catchers—the compartments to be used alternately, that is, while the screen and plates are being cleaned in one the other can be used and vice versa. Water sprays have been used for the cleaning of this air. At our station we use nothing but a screen having ¾ in. openings, as the dust we get contains very little matter that has not insulating qualities.

(48). We draw the air for cooling our generators and transformers through screens of cheese cloth and fine wire netting, and have also saved some dust by sprinkling the ground in the vicinity of the intake with oil.

80. *Do you burn coal of nut and slack or pea and slack grades wet or dry on stokers? If burned wet, how and where do you apply the water? What saving, if any, can be made by burning coal wet?*

(12). We burn nut, pea and slack coal on our stokers. The coal is wet. We apply the water to the coal with a spray pipe. As the conveyor buckets carry the coal under the spray the water is applied.

(22). We burn pea and slack coal wet on chain grate stokers and find at least 10 per cent saving in coal by so doing. The water is applied by hose in the coal bunker, and coal is given all the water it will hold.

(25). We burn a pea and slack grade of lignite coal on Green mechanical chain grate stokers. This coal is delivered to us the same day it is mined, and contains about 15 per cent moisture, and is placed in the power house bunkers in that condition. There is a slight loss in evaporation from using the coal wet. The principal advantage is the elimination of dust in handling coal on the conveyors. We consider the excess of moisture in our coal to be harmful, as it reduces the calorific value per lb. as fired and absorbs a certain amount of the heat of combustion.

(26). We burn a mixture of nut, pea and slack coal on chain grate type of stokers; the coal gets to the stoker carrying approximately 4 per cent moisture, the water in the coal is due to washing. Probably the greatest saving in burning pea and slack wet is in the labor, the damp coal mats and does not fall through the grate as badly as dry coal, thus lessening the handling cost. There is also, no doubt, a small saving due to the more even texture of the full bed, due to this matting cutting off the excess air and thus raising the percentage of CO_2, but when the cost in heat units of evaporating the moisture is taken into consideration there is probably little gain outside the labor.

(27). We use run of mine bituminous coal and crush lumps to about 2 in. or 2½ in. Burn it dry—do not consider wet coal profitable.

(48). We burn nut and pea coal (bituminous) on Babcock & Wilcox chain-grate stokers, just as we receive it from the mines, as it already contains a fair amount of moisture.

SHOPS.

82. *Describe the most practical rigging for use in removing trucks from underneath interurban cars?*

(9). Overhead crane used in connection with a yoke.

(11). First choice, overhead crane; second choice, regular car hoist using parallel I-beams on motor driven screw jacks.

(12). Four-inch screws with I-beams on top of screws. I-beams to go down flush with top of floor. Screws driven by motor. One or both ends can be raised. Any length of car can be raised without moving. No danger from falling, as all four corners raise the same. No trestles to get lost, no blocking, will remain at height stopped.

(13). Hoist body from trucks by means of four cylindrical air hoists.

(14). We use a car hoist consisting of two I-beams above the floor, 3 ft. out from gage line, each supported by two threaded studs, which pass through the floor and are raised by worm gears and wheels driven from a motor in the pit. The controller is mounted above the floor where the operator has full view of the hoist. Pieces of rail resting on the tops of the I-beams are lifted against the under side of truck frames or car bodies, raising one or both ends of car with or without trucks. We have used this device for over a year and a half without trouble or accident.

(18). We lift a car with four hydraulic jacks, operated by oil compressed with an electrically driven pump. The trucks are then run out by hand.

(27). An overhead electric crane placed on a runway the length of the truck repair section. The crane should be arranged to raise either one or both ends of car clear of trucks.

(33). By running the car over a truck turn-table, lifting the car body with a crane by means of a yoke, dropping supports upon which the side sills of the car rest. Lower the car body to the supports. Turn truck on turn-table and run the truck from underneath the car.

(34). The method most practical for use in removing trucks from underneath cars depends largely on shop arrangement, especially with reference to location of truck and motor overhauling shop, to tracks on which cars are brought into shop; for instance, on our elevated division, our overhauling shop is located on the floor below tracks on which cars are run in for overhauling, and in which case it is necessary for us to lower trucks on elevator. We remove the trucks by slightly raising the truck and car body with elevator and then swing struts under body, which will hold same in place as truck is lowered into the shop. Temporary truck is then raised up and installed under car body so that car can be moved out of the way. We find this arrangement very satisfactory. In our most recently constructed surface shops we have provided traveling cranes for lifting of car body from trucks; these cranes are so arranged as to lift the two sides of body simultaneously, and we believe that this method is the most practical, as in this way we also have the use of crane for lifting motors, wheels, etc., in connection with the overhauling.

(42). Water or air lifts—each side of pit tracks disappearing into pit space below.

(43). We use a screw lift motor-driven.

(48). In our repair houses we have two carjacks, each consisting of a pair of I-beams, one on each side of track, raised simultaneously by a set of screws operated by motor and sprocket chains in the pit below, with which we can in a few minutes raise the car body clear of trucks or lift body and trucks together clear of wheels. This outfit was made at moderate cost and is very efficient. We have also an outdoor arrangement consisting of two parallel frames about 24 ft. high, with adjustable cross beams and a set of chain blocks, by means of which we can lift a car on slings. This was originally made for loading and unloading cars, but it is also used for changing trucks.

EQUIPMENT.

86. *In a quadruple equipment of motors what will be the effect on the motors of using wheels of unequal diameter? For example, one truck has one pair of 33-in. and one pair of 34-in. and the other truck 31-in. and 32-in. wheels. What is the maximum allowable difference in diameter? Why?*

(1). Rocking car and wearing flanges to sharp edge. Not more than ⅛ in. difference.

(5). 2-10 in. Counter electro-motive force will be increased and difference in diameter absorbed.

(8). We endeavor to use same diameter wheels. Maximum is ½ in.

(11). Have a tendency to overload motors and cause cars to bind hard on sharp curves, causing heavy flange wear. ¼ in. should be maximum difference allowed.

(12). The motor on axle with large wheels will heat more than others.

(13). This causes unequal load distribution on motors. Do not think it advisable to allow a difference in diameter greater than ½ in.

(18). Most of our cars operate on under trolley and the plow is carried on the truck frame. It is, therefore, necessary for us to make sure that the truck frame is practically level.

(27). The smallest diameter wheel exerts the greatest tractive effort and likewise the greatest diameter wheel gives the maximum speed, all other conditions being equal. On the other hand, wheels of the smallest diameter are called upon to do less work than the wheels of the largest diameter. For the best results all wheels should be the same diameter or as close to the same diameter as is practical to keep them.

(34). When motors on different trucks are connected in parallel, the motors connected with the larger diameter of wheels would take a slightly larger per cent of the load. We have no standard limits between minimum and maximum diameter of wheels for use under the same car or truck, but we aim always to have the diameters of wheels as nearly alike as possible.

(43). In our quadruple equipment of motors from an electrical standpoint we find no difference. Our wheels vary in size from 29½ in. to 34 in., but we aim to have all wheels under the same car as near the same diameter as possible in order to get the proper braking results.

(48). A serious difference in wheel diameters would result in commutator trouble on the motor with the larger wheels, and a greater tendency for the other motor to slip when accelerating rapidly on series. The maximum allowable difference should be about 3-16 in. diameter.

89. *Do you press gears on axle without keys? If so, have any come loose? What tonnage do you use per in. diameter of gear fit?*

(3). We never use keys with solid gears; have never had a gear come loose; we use about 8 to 10 tons per in. of gear fit.

(9). Yes. Have not had any come loose. Gears are pressed on with about 10 tons per in. diameter of axle.

(12). Yes. No. Ten tons per in. diameter of fit.

(13). We press gears on axles without keys. They do not come loose. Ten tons per in. of diameter.

(14). We press all solid gears on axles without keys. This has been our practice for three years and we have had no solid gears come loose. We use 10 to 12 tons per in. diameter of gear fit.

(18). Yes. None loose in the last four years. Ten tons per in.

(27). Yes, standard practice. None, where work is properly done. From 10 to 12 tons per in. of diameter.

(34). Gears are pressed on all new axles without keys, no trouble has been experienced from gears becoming loose. We use approximately 10 tons per in. in diameter for pressing on gears.

(35). We shrink gears on axles. None have ever come loose. Allow .001 in. per inch of diameter for shrinkage.

(36). All gears pressed on with a hydraulic pressure of 45 tons on a 9 in. ram. All gears are keyed and no loosening has developed.

(42). No. Use keys with gear pressed on 5 tons.

(48). We press our gears on with a small key, at from 5 to 7 tons per in. diameter.

97. *What is the best method of cleaning the outside of a car at a reasonable cost without injuring the varnish?*

(1). We dissolve about ½ lb. of soap in a bucket of luke warm water and wash off the cars with a sponge. Then we use cold water, drying them off with a chamois skin.

(5). Clear water used only once from running and of course a little oil soap.

(9). Water with a small amount of oil soap.

(12). We scrub with warm water and soft soap, home made. Wash off with cold water and chamois. We believe it does not injure varnish.

(13). Wash with clean, cold water and, if necessary, use linseed oil soap.

(14). We use a good neutral oil and emulsion cleaner, using a higher percentage of emulsion for the dirtiest cars. After mixing we add 10 per cent of water (necessary to remove water marks and stains). This applied either with cotton waste or with a 5-in. flat car scrub of bristles, using the scrub brush only enough to loosen the dirt. The car is then wiped thoroughly dry with clean cotton waste and is washed each night with clear, cold water, applied with a large long-handled car washing brush. Under this method the oil and emulsion treatment is necessary at periods of 2 to 6 months, as the daily washing takes off the dust and prevents its becoming imbedded in the varnish. The oil and emulsion treatment costs about 40 cents per car and one man can take care of 35 to 40 cars, giving the oil and emulsion treatment when necessary, and the daily washing with clear water.

(18). Wash with good soap and water, then rinse off well with clean water.

(27). Oil soap diluted in proper amount of water. After application the surface must be thoroughly cleaned with clear water.

(42). Clean water and brush, drying with chamois skin.

(43). We know of no method whereby a car can be cleaned at a reasonable cost without injuring the varnish. It must be either a high maintenance for cleaning and save the varnish or low maintenance for cleaning and injure the varnish.

(48). We have obtained good results with soft brush and tubular handle, attached to hose and water supply. For washing down before painting, etc., use water with a small amount of Pearline, sufficient to soften the water.

98. *What is the best method of treatment of canvas roofs on which the paint surface has cracked and become unsightly?*

(1). We fill up the cracks if not too bad. If the cracks are too bad we remove the paint.

(3). Burn off and repaint.

(5). Put new cover on.

(8). Have had no such trouble. We keep roofs well painted all the time.

(9). Two light coats of paint will greatly improve the appearance of the roof.

(12). Scrape high edge of cracks, fill cracks with paint well thinned with turpentine, then apply one heavy coat over entire roof.

(13). The trouble is probably caused by use of too much paint on roof. In cases where roof leaks are found, these should be repaired by repairing canvas and using very little paint, as a heavy coat of paint develops cracks more easily than a thin one.

(14). If the canvas is not rotted but the paint is cracked and unsightly, a fairly presentable and lasting job may be done by applying a thin, elastic roof paint with saturated waste, rubbing cross-wise of the cracks or in circles until the cracks are completely filled. All surplus paint not remaining in the cracks should be thoroughly wiped off with the same waste. This treatment will do away with all danger of leakage but the old cracks will still show. We have been unable to burn the paint off these roofs with good results, as the canvas scorches in the cracks before the paint begins to blister, and it is practically impossible to scrape the paint off without tearing holes in the canvas over projecting nail or screw heads and bits of putty.

(27). First clean the roof with a stiff wire brush, then apply a coat of paint in semi-paste form with one-half linseed oil and one-half turpentine to the gallon and a small amount of japan dryer. This paint should be worked in well with the brush. The second coat of paint should be thinner and contain ⅔ linseed oil and ⅓ turpentine and small amount of japan dryer.

(34). Our foreman painter states that he has used linseed oil mixed with a small quantity of turpentine and dryer for filling cracked roof canvas, with good results.

(36). Scrape the old paint off with a hand scraper and repaint with ochre and raw linseed oil.

(42). Fill up cracks with several coats of good linseed oil paint.

(43). We use a thick solution of roof paint to fill cracks on canvas roofs then repaint the whole roof.

(48). We have not experienced this trouble. We paint our roofs with red lead.

100. *What is the best method of removing wrinkles and sags in thin sheet steel (16 or 18 gage) to be used for flat panels?*

(5). We roll them under boiler-makers rolls.

(14). We cut the metal panels to size and pass them through a set of plate bending rolls, breaking them first in one direction and then in the other. The panels are left slightly convex where they go against the furring strips, so that the screws or moulding around the edges pull them down flat. Lower side panels are stiffened and improved by turning the lower edge under the side sill and fastening up with screws from below. Panels finish much better for being sand blasted before painting.

(27). Metal rolls.

(28). Run the sheets through rolls (by some known as mangles); this should be done before laying off and drilling for application.

(42). Cannot be done.

(48). Use hammer and surface block.

101. *What type of lightning arrester have you found most suitable for car use, and where should it be located to give the best results? What method of inspection is most satisfactory? How can it be determined whether or not the arrester is working properly?*

(1). We use the Westinghouse style, No. 47417. We use two located on platforms of car between circuit breaker and controller. By examining after storm.

(8). Garton-Daniels. Located in motorman's cab direct from trolley cable. Use a lead pencil on wood handled screw driver.

(13). Spark gap, with choke coil gives satisfactory results. Locate in car if convenient and connect between circuit breaker and controller. Test air gap by closing with a carbon point; also test ground connection. Use lamp bank for making this test.

(17). For car lightning arrester we have always regarded the General Electric type M, form D-2, arrester as quite reliable and effective. The late styles of Garton are quite good. If allowable would place one of each on every car. We believe in locating them under platforms of cars in protected section, in accessible place for inspection. On our interurban cars we have one under platform, also one G. E. type M on roof of car, near trolley stand, with straight leads from trolley stand to the grounded whistle pipe in forward end. We inspect car arresters after big storms or at convenient times. In such inspection we remove covers for examination. We also use a test 5-light series cluster, which we shunt across the arrester terminals.

(18). We use several types of lightning arresters, and do not know which one to consider best. We believe the arrester should be placed as near the trolley as possible. On some types of arresters a test can be made by starting the arc by a piece of damp paper.

(27). There are a number of lightning arresters, but none are absolutely satisfactory. To give best results lightning arresters should be as close as possible to trolley base. Every overhauling day during summer months the arresters should be inspected—accurate and safe way to tell the working of arresters.

(34). No choice. Location underneath car body, so as to provide the shortest and straightest circuits to trolley. Lightning arrester to be connected ahead of circuit breakers or switches to ground. Inspect all parts where possible. Apply high tension test and see that adjustment is proper.

(36). The most satisfactory lightning arrester is the G. E. type MD-2. It should be located between the fuse box and controller. After all lightning storms lightning arresters are inspected and the air gap adjusted to a standard gage. A general inspection every six months is made in addition to the inspection after each storm.

(42). Garton-Daniels under car floor kept dry. Test with paper slips.

(43). We use General Electric lightning arrester. Keep the carbons adjusted to 1/64 in. gap. Lightning arresters are placed under front platform of car about 3 ft. from controller. We are not troubled with lightning in this section of the country and have no particular inspection of arresters.

(48). We use magnetic blow-out type, located underneath car, with a choke coil in main trolley line between tap to arrester and apparatus. All the inspection required is occasional examination and keeping them clean. Owing to the freedom from thunderstorms here we scarcely require them, except to protect the car from high-voltage discharge due to cross wires.

102. *Would it not be desirable to have a separate lightning arrester for lamp circuit?*

(1). Yes.

(5), (8), (18), (27), (34), (42). No.

(14). Do not think so. Lamp circuit burnouts from lightning are too rare to justify the addition of separate arresters.

(17). We do not approve of a separate arrester for light circuit for this reason: Lightning does not strike a light circuit unless it is an extra heavy discharge. In such heavy discharge the flow of current is so large at that point as materially to reduce the voltage on other portions of the line, which would have a tendency to reduce punctures, if we may use that term, at some other more vital part or apparatus. Light circuits are cheaper than armatures.

(48). Not if the main arrester is connected so as to protect the lamp circuits.

103. *What comparative results have you obtained with carbon, tantalum and tungsten lamps? State type of lamp and character of car service?*

(1). The tungsten lamp does not prove very satisfactory to us on account of film breaking through vibration caused by jolting of car.

(5). Cannot use any of these on our lines, owing to vibration.

(9). Have used Buckeye tantalum lamps on city and suburban service with a fair degrce of success. Cars on which these lamps were used were on 18-ft. and 25-ft. car bodies, single and double trucks.

(17). We have used 16-cp 120-volt carbon lamps for car and general service altogether, except for one lot of 16-cp 120-volt tantalum lamps used recently. The tantalum lamps proved very unsatisfactory on account of burning out when we had realized only a small fraction of their rated life, which was represented to us as being as long as that of carbon lamps. The tantalum lamps were short-lived whether installed in the 600-volt d. c. lightning circuit of our interurban cars, or in pendent sockets in our car barn.

(27). So far tests of tantalum filaments have been unsatisfactory.

(33). Depends upon the angle at which the lamp is placed, due to the sagging of the metal filament. When placed at an angle of about 15 deg. from vertical, test showed the life of the lamp to be about the same as the carbon filament. The light of the tantalum or tungsten lamp is more brilliant and pleasing to the eye. The test shows that more lamps were taken from the cars by the traveling public.

108. *Have you experienced any difficulty in removing solid rolled steel wheels from axles? What means do you employ?*

(3). Sometimes necessary to heat hub of wheel before pressing off.

(5). No. Use a 300-ton wheel press and start with hammer blows.

(8). No. Use a wheel press.

(9). Yes. Means used to remove them was to use full capacity of wheel press, (150 tons) and in addition, the use of a sledge.

(11). Solid rolled steel wheels and cast steel centers always require higher starting pressure in backing off than in pressing on. The axles at wheel fit should be highly finished, the wheel center rough bored within .002 in. of pressing fit and then taken to size with a smooth finish. Use whitelead mixed with machine oil. These precautions overcome most of the difficulties with this class of wheels. Where we had only 150-ton press, found it necessary to rig up a pile driver and jar axles several times, after which wheels could be pushed off with ease.

(12). Yes, heat and hammer when under pressure.

(13). No. Use hydraulic press.

(14). We have had no trouble in removing steel wheels though they sometimes require 250 tons or more to start.

(27). Yes, due to improper fitting of wheel on axle. By a number of schemes, such as heating wheel hub with gasoline torch, also turn hub down, drill same, and drive taper plugs in the hub.

(34). We have experienced no difficulty in removing solid rolled steel wheels from axles. We remove these with hydraulic press.

(42). No. Heat wheel with torch, press off.

(43). We have experienced some difficulty in removing solid rolled steel wheels from axles. We heat the hub of wheel with gasoline torch before undertaking to press off.

(48). We have found in some cases a tendency for steel wheels to bind, though pressed on with lower pressure than iron wheels, but have no difficulty in removing them after heating the hub quickly.

109. *What have you found to be the most economical basis for turning rolled steel wheels, i. e., how much wear of flange and tread do you allow before turning? State method used in inspecting and cost per car mile; also character of service?*

(3). We rarely turn wheels on account of tread wear, as the flange generally wears out first. We let wheels run till flanges wear down to ¾ in. in thickness. We inspect once a week with limit gage.

(5). Allow minimum 11/16 in. flange. Interurban regular and limited urban and city.

(8). Never turn till necessary on account of sharp or double flange.

(12). By flange wear. When flange wears from 1¼ in. to ⅞ in. thick. Do not turn wheels if flanges are good and wheels are same size.

(13). We turn wheels when we find a variation in the circumferences of two wheels mounted on same axle, of ⅛ in. Other conditions, however, have to be considered, and for this reason, we have been unable to establish any positive basis. Wheels should be turned when flange is worn to a thickness of ⅝-in. at a point ⅜ in. above gage. For the last wear, this may be worn thinner. For inspection, we use a wheel tape and flange gage. Service—interurban.

(27). When flanges are less than ¾ in. or greater than 1⅛ in. in width, wheels should he turned; should have metal gages for the use of inspectors. Character of service, city and suburban.

(34). We believe the most economical basis for turning of rolled steel wheels is that which will result in the least number of turnings, and we endeavor to wear out wheels having a 2-in. thickness of rim with only one turning. We inspect wheels for thickness and height of flange on regular inspection periods by use of limit gage; also for any defects. Wheels for our elevated service are turned when the thickness of flange has been reduced 5/16 in. or when it is ¼ in. above standard height. Wheels used on our surface lines are turned when the thickness of flange is reduced 7/32 in.; the latter wheels when new have flange 1 in. wide by ⅝ in. thick. The elevated wheels have standard M. C. B. flange and tread.

(43). We allow ⅛ in. flange wear before turning. Pay no attention to tread wear. Steel wheels are inspected every 30 days.

(44). Flanges are gaged on the 1,000-mile basis.

(48). We find it necessary to remove steel wheels for flange wear before the tread has worn badly. We would not allow more than ¼ in. flange wear. We test our wheels with a gage similar to the M. C. B. gage.

118. *Is it desirable to use an unflanged brake-shoe on solid rolled steel wheels? Why?*

(5). No. Difficult to keep in place.

(6). No. Unflanged shoes are not practical with narrow tread wheels, or where there are no brake beams, and when applied on brake beams increase considerably the tendency of wheels to wear sharp flanges. A flanged shoe increases the braking effort fully 25 per cent, holds the shoe in its proper place on the wheel; diminishes flange wear; gives a more uniform braking effort and reduces the cost of maintenance.

(8). No. We get better service from wheels and shoes with flanged shoe.

(12). Cannot see any difference in flange wear since changing from unflanged shoe to flanged shoe.

(13). Yes, if brake shoes could be held in proper position without flange. Flanged shoes very often are responsible for rapid wear of wheel flange.

(14). Our experience shows a decreased braking effort with flangeless shoes on rolled steel wheels.

(17). Unflanged brake shoes on steel-rolled wheels have their advantages. They eliminate part of brake chatter, and also prevent some of the side wear on the wheel flange. The flanged shoe has its advantages inasmuch as the shoe in the start adjusts itself nicely to the contour of the flange and tread, also has a tendency to wear off the sharp edges of flange. With our equipment the flangeless shoe would not give satisfaction, as it would require rigidly supported brake hangers and heads.

(19). It is not desirable to use unflanged shoes on any wheels of electric railway trucks for the reason that the increased area due to the flange is required for braking and to reduce rapid abraiding of the shoes. By increasing the area of the shoes in contact with the wheels, we reduce the amount of metal that will be cut away by the brake application. Flangeless shoes should not be used on any trucks which are not provided with brake beams, as the flange is required to hold the shoe in position on the wheels.

(34). No; we believe it desirable to use flanged brake shoes on steel wheels as we find that this practice will prevent high flanges, with the consequent necessity for turning.

(42). No. Crowd off to one side, damages wheel.

(48). No. There should be sufficient flange on shoe to equalize with tread wear, or otherwise the flanges get too deep and injure the special work at intersections and frogs.

123. *What is your practice for squaring up various types of car trucks that have been damaged in car collisions?*

(12). Take apart, heat and straighten.

(13). Use a tram and if trucks are out of square, it sometimes is found necessary to disassemble truck, straighten bent parts and rebuild.

(14). Consider journals as being corners of a rectangle and square up the truck by pressing with jacks or by other means until diagonals of rectangle are of equal length.

(19). Cut the frames apart, then heat, straighten and re-rivet them. If only slightly bent, they can be heated with torches and pulled true with chains and turnbuckles.

(27). Center of pedestals should be squared up three ways, viz.: across frame, length of frame and diagonally.

(28). To square up truck frames damaged in collision we heat with gas flame and by using jacks and screw clamps have no difficulty in bringing back to proper position.

(34.) When trucks have been damaged in collision we square them up by measuring diagonally across pedestal centers.

(43). We tear down truck, run through blacksmith shop and square up to a gage.

(48). We gage our trucks by measuring from journal box center to center across each end, and between diagonally opposite centers.

POWER PLANT OF THE PORTLAND RAILWAY, LIGHT & POWER COMPANY

The dam of the new power plant of the Portland (Ore.) Railway, Light & Power Company is located on the Clackamas River at River Mill, 1 mile from Esclada. In place of the usual type of solid-masonry dam the Ambursen reinforced-concrete hollow design is used.

The dam is 680 ft. long, 80 ft. high and 150 ft. wide at the base. It consists of a series of parallel supporting walls, spaced 18 ft. on centers and built in the general direction of the stream, and reinforced concrete slabs span the spaces between the supporting walls to form the upstream face. An interesting feature of the construction work is the grouting of the foundation material underlying the dam, in order to secure the foundations against erosion and to prevent the waste of water by seepage beneath the dam.

The power house is built contiguous to the dam and is 173 ft. long x 60 ft. wide. Floor space for five units is provided, each unit consisting of a Victor Francis turbine developing 6000 hp, and a 3300-kw alternator. Only three units will be installed at present, but ultimately the other two will be placed. The plant will be in operation early in the fall and will furnish additional energy for the railways and lighting system in Portland and the vicinity.

The Philadelphia Rapid Transit Company has made new arrangements for the handling of coal for use in its various plants. Heretofore the coal was brought to Philadelphia by barge and unloaded at the yards of the George B. Newton Coal Company, but now the latter company has erected a large concrete and wood coal pocket along the Schuylkill River close to the Chestnut Street bridge. This pocket is erected in such a manner as to allow the freight cars of the railway company to run under chutes. Coal is carried into the pocket by means of bucket chains from barges in the river.

Discussion at Friday Morning Session of the Engineering Association

A Report of the Discussion of the Reports of the Committees on Equipment, Rules of Procedure of the Committee on Standards and the Concluding Business of the Association, Including the Election of Officers

The final session of the Engineering Association was held on Friday morning. The first order of business was the report of the committee on equipment. This report, which was reviewed by M. V. Ayres, is printed elsewhere in this issue.

EQUIPMENT

H. S. Williams, Peter Smith Heater Company, referred to the committee's comparison of various systems of car heating wherein it was stated that the cost of operating the hot-water system, including only the items of fuel and labor, was approximately the same as the cost of operating the hot-air heater. He said that this was somewhat in error, as the hot-air heater was of much higher efficiency than the hot-water heater. In fact, the hot-air heater was from 25 per cent to 35 per cent more efficient from a coal-burning standpoint. The coal consumption of 85 lb. a day for the hot-air heater as given in the report was not based on facts, but was an assumption. Where 85 lb. of coal were required for the hot-water heater approximately 60 lb. were needed for the hot-air system. So the item for coal should be $33.71 instead of $46. If the coal consumption was assumed at 85 lb. a day for the hot-water system an equivalent amount of heat could not be obtained by the use of 5 kw in the electric heaters. If the comparative costs were to be of any real value they must be made on the basis of supplying the same quantity of heat. On the basis of 50 per cent efficiency for the hot-water heater, and assuming that the heater consumed coal at one-half the rate while out of service that it did when in service, the quantity of heat delivered by the hot-water heater during the 13½ hours would be 366,000 B.t.u. This amount of heat was equivalent to 107-kw hours a day, or approximately 8 kw instead of 5 kw, as shown by the report. Consequently the cost of electric power should be $218.95 instead of $137.03. The item of $12 for insurance charge against the hot-water and hot-air systems was not applicable to general conditions. This was a situation peculiar to the city of Chicago, which was not under the jurisdiction of the National Board of Fire Underwriters. The first cost of the hot-air heater of the capacity required for the 32-ft. car should be $135 instead of $155. The item of depreciation on the hot-air system was too low, and it was fairer to assume 10 per cent depreciation instead of 7 per cent. Consequently the estimate for heating costs should be corrected as outlined, and with these alterations the estimate should be as follows:

COMPARATIVE COST OF HEATERS.

	Electric.	Hot Water.	Hot Air.
Cost of power	$218.95	.....	8.22
Repairs and maintenance	1.90	$4.35	2.90
Interest and depreciation	8.80	18.75	20.25
Coal	.....	47.76	33.71
Labor of attendance	.....	8.70	8.70
Hauling	20.00	60.00	20.00
Total	$248.84	$139.56	$93.78

Secretary Litchfield said that most people in talking of the design of cars for light weight seemed to have confined their attention largely to the side frames, as if the side frame were the whole car. On the last car his company had built he had made a very careful advance detailed estimate of every part of the car. He had had each part listed, first dividing the whole car into various classes of parts, then listing each part carefully, checking them off from the drawings, then checking back after the car was built. The estimate came out very close to the final car. He thought that it might be of some interest to note the short list of percentage weights. He would not give any figures for actual weights, because all cars varied so. This particular car was built for a peculiar service, that is, for use in the New York subway, where they run ten-car trains with a motor-car weight in the neighborhood of 73,000 lb. or 74,000 lb. and running at an average of about 45 m.p.h. So they felt that the floor frames ought to be connected just as stiff and strong as possible. They did not make very much of an attempt to lighten the floor frame. The floor frame and the floor constituted 39.2 per cent of the total weight of the car body; the side frame, taken from the sill right up to the letter board, was only 14 per cent of the total weight of the car. That was the point that struck him very forcibly. He had had all kinds of side frames talked about to him in the reduction of weight, yet it was only 14 per cent of the total weight of the car. The sash and doors constituted 6 per cent to 10 per cent; interior framing 3.2 per cent, bulkhead 4.4 per cent, vestibules 5.5 per cent, and last, but not least, a miscellaneous item of 17 per cent. They had taken every possible thing out of that car they knew how. If others would subdivide their cars that way into percentages they would find something of interest.

Referring to requirement No. 5 for interurban couplers Mr. Litchfield asked for information regarding the amount of the strains for which provision should be made in designing couplers.

F. G. Grimshaw, Pennsylvania Railroad said that the committee had not attempted to consider the stresses which couplers ought to withstand and had not gone into the details of the design. The committee thought it was wise to outline general requirements before attempting to specify definite dimensions or details of the design.

George L. Fowler, New York, said that it was practically impossible even to estimate the stresses in parts of a car when it was in motion. He referred for example to the stresses in bolsters. He had found in one case with a static load on a bolster of about 45,000 lb. the actual stresses while the car was running 27 m.p.h. on smooth track varied from 60,000 lb. to 70,000 lb. If he were to make a guess he would say that the stresses in street railway cars when running were something more than 100 per cent greater than the stresses when the car was standing still.

W. H. Evans, Anderson, Ind., thought that there was a fine field for investigation of the stresses in couplers when cars were pulled around curves of sharp radius. He thought the manufacturers of couplers would be glad to co-operate in such an investigation.

M. V. Ayres called attention to the fact that under the heading of requirements the committee had included one statement regarding the desirability of having the shank of the coupler of such dimensions that it could be replaced readily by an M. C. B. passenger coupler. This, he thought, was put a little too strong. It was a desirable feature rather than a necessary requirement.

Rodney Hitt, Electric Railway Journal, asked if any couplers were now being made for interurban service which were arranged not only to permit of uncoupling without going between the cars but which would also permit coupling without compelling the operator to go between the cars and open the knuckle. Nearly all M. C. B. couplers of

recent design included this feature of a knuckle opening device.

W. H. Evans replied that a number of couplers had been designed for interurban service which embodied that feature.

H. H. Adams brought up the question of "squealing" of brakeshoes on steel wheels. A great deal of trouble had been experienced in New York and the problem seemed to be a particularly difficult one to solve. The squealing was especially severe where new rails had been laid. His company had studied the problem and had finally been able to work a considerable improvement by using a type of flanged brakeshoe containing an asphaltum lubricant compound placed in a pocket in the flange. This remedied the "squealing" but Mr. Adams was not altogether satisfied with it as a means of permanent relief.

George L. Fowler, New York, said that he had given this subject considerable study. He had obtained data which would prove that the "squealing" was due to the brakeshoes, to the wheels or to the rail. He proposed to begin a complete investigation this winter in which he intended to use a telephone apparatus for locating the origin of the squeal.

W. Thorn, Chicago, said that considerable "squealing" had been noticed in that city. In one case it was thought to be due to excessive sprinkling of the street which caused the rail to be constantly wet. He thought that the type of truck had something to do with "squealing."

W. H. Evans, Anderson, was of the opinion that "squealing" might be due to the location of the brakeshoes on the wheels, the play in the brakeshoe hangers and possibly to the manner in which the brakes were handled by the motormen.

On motion, the report of the committee on equipment was accepted and its recommendations were approved.

RULES OF PROCEDURE OF THE COMMITTEE ON STANDARDS.

Rodney Hitt, Electric Railway Journal, presented the report of this committee. He called attention to the fact that the committee had inserted two amendments to the rules as printed in the advance copies sent out. The first of these was an addition to section 3, making the secretary of the Engineering Association secretary of the committee on standards. A new section, numbered 9, was inserted in the rules and covered the powers of the committee on standards to lower a proposed recommendation from standard to recommended practice.

The report of this committee, including the amendments presented at the convention, is printed on another page in this issue. On motion, the report of the committee, as amended, was adopted.

STANDARDS

H. H. Adams presented the report of the committee on standards, which will be found elsewhere in this issue. He called attention to the fact that the committee had reduced a number of the recommendations of the standing committees from standard to recommended practice because it felt that it was not wise to adopt them for the first time as standard. The report of the committee on standards was then taken up, section by section.

The recommendations of the committee, sections A and B, were approved.

A. T. Clark, Baltimore, objected to the gage for mounting wheels recommended by the committee for adoption as recommended practice. Mr. Clark's objections related to the dimension of the height between the base line and the gage line, shown as 17/64-in., which did not correspond to the standard dimension of ¼ in. He also desired to have the word "maximum" struck out in the dimension showing the wheel gage. The radius of the throat of the flange was shown on the drawing as ⅜ in., whereas it should be ½ in.

W. H. Evans also raised objections to the type of wheel gage shown in the report and made a motion that the design of this gage be referred back to the committee on equipment for further investigation. In his opinion it was a very crude form of wheel gage, and he thought that a very much better gage could be devised. His motion was carried and the gage was referred back to the committee.

N. W. Storer, Westinghouse Electric & Manufacturing Company, objected to the taper for pinions recommended by the committee for adoption as standard. The standard taper for pinions of Westinghouse motors was 1.213 in. to 1 ft. He did not know how this unusual taper had been adopted originally, but speaking for the Westinghouse Electric & Manufacturing Company, he said that company did not propose to change its own standard on the old types of motors. He did not see any necessity for adopting the proposed standard taper until such time as a complete design for standard pinions could be prepared. If any new standard were adopted, he would suggest a taper of 1 in 10 which corresponded to 1.2 in. in 1 ft. Such a decimal taper could be used equally well with the English or metric systems of measurement.

On motion, the recommendation of the committee on standards that a taper of 1¼ in. diameter to 1 ft. of length be adopted as standard, was carried. All of the other recommendations of the committee were then submitted to vote and approved.

GENERAL BUSINESS

The first subject discussed under this head was the disposition of the "Question Box," which is published in abstract elsewhere in this issue. Owing to the lateness of the hour, there was no discussion on the "Question Box," but a motion was made and carried that the "Question Box" be accepted and printed in the proceeding with such additional answers to the questions as might be received up to the time of printing the proceedings.

H. H. Adams presented to the association a copy of the Electric Railway Dictionary, to be kept in the secretary's office.

A motion was made that a vote of thanks be given to all of the association committees for their excellent work during the past year, and also a vote of thanks to the secretary. The motion was carried.

ELECTION OF OFFICERS

The next order of business was consideration of the report of the nominating committee, which had been presented earlier in the morning. The following named gentlemen were nominated for office to serve during the coming year:

President, E. O. Ackerman, Columbus (Ohio) Railway & Light Company.

First vice-president, Martin Schreiber, Public Service Railway, Newark, N. J.

Second vice-president, L. P. Crecelius, Cleveland (Ohio) Railway.

Third vice-president, John Lindall, Boston (Mass) Elevated Railway.

Secretary-treasurer, Norman Litchfield, Interborough Rapid Transit Company, New York City.

Members of the executive committee: J. H. Hanna, Capitol Traction Company, Washington, D. C.; E. J. Burdick, Detroit (Mich) United Railways; E. R. Hill, Pennsylvania Railroad, New York City; H. A. Mullet, Milwaukee (Wis) Electric Railway & Light Company.

On motion, the secretary was instructed to cast one ballot for these nominees.

E. O. Ackerman, the new president, was escorted to the chair, and in a brief speech he said that it gave him a great deal of pleasure to accept the office to which he had been elected. He considered it a very high honor and wished to assure the members that he would use every effor to further the interests of the association during the coming year.

A motion to adjourn was then made and carried.

GERMAN STREET RAILWAY STATISTICS FOR THE YEAR 1909

Official statistics for the fiscal year ended March 31, 1910, show that there were 259 street railways in Germany operating 4277 km (2652 miles) of route, of which 3047 km (1889 miles) were located in Prussia. The total increase in mileage over the preceding year was 6.07 per cent for all Germany. The largest company is the Grosse Berliner Strassenbahn and its subsidiaries, operating 344 km (213 miles) of route. The largest ratio of route to population is possessed by the Rhine provinces, which show 1.46 km (0.91 mile) per 10,000 inhabitants.

The great majority of the lines are either of meter (39.37 in.) gage, or 1.435 m (4 ft. 8½ in.). The meter gage lines constitute about 60 per cent and the standard gage lines about 20 per cent of the total. About 83 per cent of the railways are electrically operated, the remainder being served by steam, cable or horses. On 174 Prussian lines, aggregating 2967 km (1840 miles), there were 59 steam locomotives, 54 electric locomotives, 7676 electric motor cars, 13,513 trailers and 1731 miscellaneous cars for freight, mail, etc. The average seating and standing capacity of a trailer is given as 33.4 and the average load of a freight car as 5.2 metric tons. The German railways, outside of Prussia, operated 12 steam locomotives, 14 electric locomotives, 3166 motor cars, 5283 trailers and 558 miscellaneous cars. The average seating and standing capacity of these passenger trailers was 35 and the average capacity of a freight car 6 metric tons. The Grosse Berliner Strassenbahn operated 2563 cars, which had a total seating and standing capacity of 87.885, or 34.2 passengers per car. It should be stated that the capacity of a car is based on the number of seats and the legally permitted number of standing places on the platform. Passenger transportation exclusively was the business of 68.7 per cent of the Prussian lines and of 77.3 per cent of the other German lines.

The Prussian railways had 41,115 employees, 12,394 of whom were employed on the Grosse Berliner Strassenbahn alone. In Prussia 93 systems and in the rest of Germany 30 systems were privately owned and operated; for the preceding year the corresponding figures were 97 and 41. Most of the privately owned lines are confined to single systems, but one company owns seven railways in as many cities, aggregating 123 km (76 miles).

During the year 2,136,738,595 passengers were carried for 597,120,042 car km (370,214,246 car miles), 75 1/6 per cent of which was motor car mileage. There were carried 1,429,824 metric tons of freight over 2,788,226 car km (1,728,700 miles). The corresponding figures for the preceding year were 352,896,439 passenger car miles, 1,308,531 metric tons and 1,613,218 freight car miles. The total gross earnings of all lines (except 56 miles) were 220,741,177 marks ($55,185,294), an increase of 5.9 per cent over the preceding year. The total operating expenses for all lines (except 134 miles), including taxes and welfare work for employees, were 138,759,293 marks (34,689,823), an increase of 4.1 per cent over the preceding year. This was the first time in many years that the operating expenses did not increase in greater proportion than the income.

The largest street railway gross income according to unit length of route was obtained by the Grosse Berliner Strassenbahn, which earned 152,164 marks per kilometer ($60,865 per mile), but this was greatly exceeded by the Berlin elevated subway system, which earned 369,286 marks per kilometer ($147,714 per mile). The Hamburg Street Railway obtained the highest average fare per passenger, namely, 12.8 pfg. (3.2 cents). The average annual earnings per kilometer on all systems in Germany were 52,785 marks per kilometer ($21,113 per mile) and the income per passenger 10 pfg. (2½ cents). In general the average earnings per unit length of route increased 1.8 per cent over the preceding year.

The actual operating expenses of all companies constituted 86½ per cent of the total gross income. There was a slight average improvement in net earnings. Of 159 Prussian street railways, 21 declared no dividend, 4 paid up to 1 per cent, 15 between 1.1 per cent and 2 per cent, 7 between 2.1 per cent and 3 per cent, 23 between 3.1 per cent and 5 per cent, 63 between 5.1 per cent and 10 per cent, and 10 paid dividends of more than 10 per cent. Of the 52 non-Prussian railways, 5 paid no dividends, 4 paid up to 1 per cent, 5 between 1.1 per cent and 2 per cent, 8 between 2.1 per cent and 3 per cent, 9 between 3.1 per cent and 4 per cent, 3 between 4.1 per cent and 5 per cent, 16 between 5 per cent and 10 per cent, and 2 paid dividends of over 10 per cent.

The accident statistics show that 10 employees and 218 non-employees were killed and that 102 employees and 918 non-employees were severely injured. The number of deaths decreased almost 11 per cent, but the number of severely injured increased 2 per cent as compared with the preceding year.

REPORT ON STREET RAILWAYS IN AUSTRALIA AND TASMANIA

The report of G. H. Knibbs, Commonwealth statistician of Australia, for the year ended June 30, 1910, shows a total tramway mileage on that continent of 442 miles as compared with 389.75 miles at the end of June 30, 1909. Of this total 275 miles are operated electrically, an increase of 23.75 miles over the preceding fiscal year. New South Wales has 112 miles of electric traction and 58 miles of steam traction; Victoria still has 46 miles of cable traction, in addition to 40 miles of electric, 1 mile of steam and 13 miles of horse railway. Queensland and Tasmania are the only states using electricity exclusively, the former having 30 miles and the latter 9 miles. South Australia has 30 miles operated electrically, 3 miles by steam and 23 miles by horses. In Western Australia 53 miles are electric and 23 miles horse. The Commonwealth of Australia has 213 miles under government control, viz., 165 miles in New South Wales, 5 miles in Victoria, 20 miles in South Australia and 23 miles in Western Australia. Municipally owned tramways are peculiar to South Australia, which has 30 miles so controlled, and the total of privately operated lines comprises 199 miles, of which New South Wales has 5 miles, Victoria 95 miles, Queensland 31 miles, South Australia 6 miles, Western Australia 53 miles and Tasmania 9 miles. Further particulars with regard to energy requirements, passenger business, mileage, cost, employees, revenue and expenses are given in the accompanying table.

	Kw-hours.	Mileage Open.	Car Miles Run.	Passengers.	Capital Cost.	Gross Revenue.	Operating Expenses.	No. of Cars.	Employees.
New South Wales	45,611,000	112	19,426,000	187,537,000*a*	£4,248,170	£1,094,861	£890,882	946	6,074
Victoria, *c*	2,314,000	39	1,930,000	7,889,000	275,458*a*	54,727*a*	40,087*a*	97	317
Queensland	5,441,000	31	3,524,000	32,419,000	*b*	214,265	*b*	119	654
South Australia	4,227,000	29	2,839,000	23,647,000	866,732	168,818	123,445	100	778
West Australia	3,952,000	50	2,304,000	13,580,000	1,018,548	144,320	98,236	101	366
Tasmania	749,000	9	490,000	2,772,000	90,824	27,502	15,682	25	105
Total	62,294,000	270	30,513,000	267,844,000	£6,499,732*a*	£1,704,493	£1,168,272*a*	1,388	8,294

a Incomplete. *b* Not available. *c* Exclusive of Prahran-Malvern line, opened May 31, 1910.

Papers Presented Before the Claim Agents' Association

Abstracts of Some of the Principal Addresses Made Before the Annual Convention at Atlantic City—Selection and Instruction of Trainmen and the Prevention of Accidents

During the sessions of the American Electric Railway Claim Agents' Association at the annual convention, held at Atlantic City, N. J., on Oct. 9 to 13, papers were presented on several topics of interest. In the following abstracts it will be noted that the same subjects were assigned to two members.

THE PREVENTION OF ACCIDENTS

BY F. J. WHITEHEAD, SECRETARY AND CLAIM AGENT WASHINGTON, (D. C.) RAILWAY AND ELECTRIC COMPANY

Upon first approaching this subject, the thought seems to go immediately to the trainmen and flagmen. This is due to the fact that these men are concerned in a very large majority of the cases and, while it is necessary, of course, to increase the interest of employees in all branches of the company's service, it should not be forgotten that extreme caution should be exercised by platform men.

To make effective a plan of education for employees of the roads, its patrons and the public in general would, no doubt, do a great deal toward protecting both the transportation companies and the public. Publicity regarding rules and regulations should become of such interest that it would lessen the number of accidents and, judging by the articles which have appeared in the public prints during the past year on this subject, it would seem that many of the companies throughout the United States are adopting such a policy. To post short rules and notes of instruction in the cars would be a step in the right direction. By the use of big type and a heading to attract attention, such rules and notices would be read by thousands of persons daily and bring squarely home to them the thought of danger. Hundreds and perhaps thousands of women step off street cars in the wrong direction and in a dangerous manner every day, and a simple note of explanation might correct the danger.

In conducting a campaign of publicity it might be well to use columns of the more prominent daily papers occasionally and, if necessary, have an instructor or demonstrator on duty at certain points during certain hours or on special occasions to give warnings and instructions to the public.

Offer a prize or souvenir for the best suggestions affecting protection of persons from injury while on or about the company's cars or tracks, and thousands of persons will probably compete, getting the question before the public in a way that will do an incalculable amount of good.

METHODS OF INCREASING INTEREST OF EMPLOYEES

To increase the interest of all the employees of the railway companies is a problem. It may be possible, however, to establish an efficiency rating in all of the departments of the service; not alone for the men handling the rolling stock, but also for the office force, track men, shop men, carhouse men—everybody in the service of the company. Make it worth while for the employees. Let them have something to look forward to each year and you will have just so many more persons taking a greater interest in the company's welfare. As platform men are so largely concerned, it might be well to offer them some special inducement. Adoption of exceedingly great care and judgment would be absolutely necessary, however, if such a policy were put into effect, in order to avoid dissatisfaction on the part of the man charged with an accident which could not possibly have been avoided by him.

Passengers might also be encouraged to look after the interests of the companies because of the additional protection it means to them. To call the conductor's or motorman's attention to a spot of grease inadvertently left on the car by a careless shopman or by a workman may save the passenger some embarrassment and considerable annoyance, and the company the cost of a suit of clothes or a dress. Proper recognition of public interest will invariably lead to its growth, the result being that the road acquires a large number of friends who become competent inspectors unrewarded by company funds. The conductor or motorman who does not accept with every show of sincere courtesy suggestions made to him in this way should be sent immediately to the instruction room for further education as to his duty in this regard and, if needs be, reprimanded to such an extent that he will promptly become concerned for the safety of his job.

All employees might be called upon at stated intervals to make suggestions to improve the service and prevent accidents. Small blank forms for such a purpose could be distributed where they would be available at any time.

SUGGESTIONS FOR EFFICIENCY

Certainly the officials would accomplish much good by addressing the employees occasionally. It would be well for them to talk on subjects of vital importance to the road, telling the causes of many accidents and suggesting remedies. In order to improve the efficiency of employees it is suggested that these plans be followed:

1. Some substantial inducement for efficiency higher than the general average.
2. Issue general daily notices showing accidents occurring the day or week previous, giving the causes and calling for greater caution.
3. Require prompt and full reports of all accidents.
4. Commend platform men when the occasion warrants and post on bulletin boards all letters from the public commending men for efficiency or thoughtfulness.

In order to bring more forcibly to the attention of those who are responsible what accidents mean to their employers, it is well to forward a memorandum showing the amount of money the accident has cost the company, setting forth fully the cause and what might have been done to avoid it.

TALKS WITH THE EMPLOYEES

Heart-to-heart talks at the meetings of the employees should be the means of getting employer and employee closer together. At these meetings about two persons, one from the claim department and one from the transportation department, should be designated to give the principal talks, after which the meeting should be thrown open for general discussion. These meetings should be as informal as it is possible to make them, and trainmen should be encouraged to take part in them. Attendance should not be necessarily compulsory, but employees should be given to understand that the meetings are in the company's interests and that their interests are necessarily involved. In order to make the meetings more attractive and informal, some form of entertainment should be provided. If a platform man has an accident which requires a rigid investigation by the claim department the investigator should not start out with the presumption that the employee was at fault, but should bear in mind that by kindness and a little patience much more information can be obtained. Employees should be impressed at all times with the re-

sponsibility that they owe, as the agents of the company, to the public in the protection of life and limbs of persons committed to their keeping and who are unable, to a large extent, to protect themselves while in their care. They should be constantly taught that they have a selfish interest in operation and that accidents always result in the lessening of profits that would and should go to the company and from it, logically, to some extent to the employee.

HOW CAN THE PUBLIC BE EDUCATED IN THE PREVENTION OF ACCIDENTS?

BY B. F. BOYNTON, CLAIM ADJUSTER PORTLAND (ORE.) RAILWAY, LIGHT & POWER COMPANY

The subject is one that can be treated from a great many standpoints; but from my own observation, the most vital one and the one that will bring about the greatest amount of good is the education of the children in our public schools on what to do to protect themselves from all kinds of accidents. The rising generation can be taught easily; now, if the girls in our schools were taught to carry their books, purses or whatever they might have in their right hand or arm, their left hand would always be free and then it would be absolutely impossible for them to get off a car backward.

Three years ago we were having a great many accidents to children. We interviewed our Board of Education and requested the privilege of delivering lectures in the schools on the prevention of accidents. This was readily granted, and since that time all our city schools have been covered by lectures twice in each school year. Upon observing the success of the school work here in Portland, the companies in Seattle, Spokane and Los Angeles adopted the same method, and if any of the representatives from these cities are present they can speak for themselves as to the results obtained.

Since we have taken up this school work we have had very few accidents to children. We have found that after talking to the school children they go to their homes and relate to their fathers, mothers, brothers, sisters and playmates what the speaker has said about protecting themselves when on the city streets. Any of you who have children of your own well know the impression it makes on you when your children come home from school with something to tell which is of great interest to them. I cite this to show you that we are not only reaching the school children but also that by talking to the children we reach all members of the family; the other members of the family will listen to the child when they would not listen to you or me. We are preparing, for this season, a series of pictures to illustrate the stories told them.

I have communicated with the Board of Education in nearly every city in the United States, calling attention to the fact that, while we are educating the children of today along many important lines, we are sadly neglecting the very essential matter of teaching the child to protect its life and limbs. Now, gentlemen, the best way to prevent the numerous accidents all over our country is by this education, and the most far-reaching work that could be done would be to get every school teacher to devote at least five minutes each day to a talk to the pupils on what to do to prevent injury while on our busy streets. This in my opinion will accomplish more good than anything else that can be done.

METHODS OF REACHING ADULTS

To reach the adults in another way in our city, we are now contemplating the use of a moving picture machine to display on the side of a building on one of our prominent thoroughfares various pictures dealing with the prevention of accidents. On each picture there will be a few words to describe how the accident portrayed was brought about.

The day has passed when a claim agent's work consists only of caring for the accident after it has happened. We must direct our greatest efforts toward prevention.

SELECTION AND INSTRUCTION OF TRAINMEN IN ORDER THAT COMPLETE AND INTELLIGENT ACCIDENT REPORTS MAY BE OBTAINED

BY E. A. BECK, CLAIM AGENT BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY, LTD., VANCOUVER, B. C.

The selection of trainmen should be placed in the hands of one particular official. When the term of instruction is completed the same official who originally selected the man for service should examine him as to proficiency. The responsibility for the appointment thus will rest upon one man. The claim agent of the line should personally, so far as is practicable, impart to the new employee, with responsibility and dignity, the final instructions, as it is to this official that the trainman must eventually make his excuses in case of errors resulting in accidents.

The methods usually adopted in securing accident reports are by formal question and answer or by narrative. Prominence should be given to the narrative form, especially in primary investigation, as in this manner the trainman will, in his own way, best tell his story. The majority of trainmen object to being catechized and usually respond to questions with monosyllabic replies which do not bring out the full facts of the case. The narrative form should, however, always include questions relating to date, time, place, speed, name of person or owner concerned and witnesses.

THE ACCIDENT REPORT

The formal accident report should contain a few direct questions for stated answer, chiefly covering the specific points mentioned as necessary in the preceding paragraph. The form of the report should be such as to encourage the trainman to tell the whole story clearly and concisely, although not with the brevity of "Dog crossing track. Dog hesitated. Dog gone." It is often found that the general education of the average trainman has been neglected and the inclusion of a long list of questions on the accident report frequently confuses him and leads to his submitting a report which does not give the assistance or information needed by the claim agent.

It is not expected that a report from a trainman will be a literary production, but it is always to be expected that the statements will be truthful and in strict conformity with the facts of the case. To give assurance on this point the trainman should make certain to obtain the names and addresses of the greatest possible number of witnesses in any case where his own actions or the management of the line by which he is employed is liable to be called to account for any cause.

"Were you afraid to obtain witnesses?" "It was your duty to thus protect your company, yourself and your mate." "Others must be your judge." "An unjust claim may be made against your company." "You or your mate may be reprimanded and, possibly, discharged on account of this affair." "Every passenger is a witness, either directly or in corroboration." "Protect your company, yourself and your mate." "Observe and note carefully remarks, conditions and distances at the time of an accident."—Questions, suggestions and advice such as are noted might well be used by a claim agent when dealing with trainmen.

BLANKS FOR ACCIDENT REPORTS

Blanks for accident reports should, like the book of rules, be always "on the job." They should have printed thereon rules to be observed in case of accident and a number of pointed "Don'ts" and "Hints" for trainmen in preference to a long list of questions, many of which are superfluous. Space should also be left on the blank for a

diagram which will give full information as to the exact location of an accident.

Accident reports should be made out as promptly as possible and handed to the division superintendent or inspector, who should in turn transmit them without delay to the claim agent.

SELECTION AND INSTRUCTION OF TRAINMEN IN ORDER THAT COMPLETE AND INTELLIGENT ACCIDENT REPORTS MAY BE OBTAINED

BY E. P. WALSH, ATTORNEY UNITED RAILWAYS COMPANY OF ST. LOUIS.

As between selection and instruction of trainmen, to my mind the former is the more important. With a proper selection the instruction that is later given will prove more effective and productive of better results than if the selection be an unwise one. In fact, no amount of instruction can compensate for an improper selection. I think this fact is every day being more forcibly impressed upon those in charge of street railway affairs in this country, with the result that greater care than ever before is now being exercised in the selection of trainmen.

When it becomes necessary to add a new trainman to the service, my judgment is that the raw recruit is the preferable selection, unless the applicant be one who has worked with the same company before and left under excusable circumstances with a good record and has not been away sufficiently long to become out of tune with the system's ways of operation. There are, of course, exceptions, but as a general rule the experienced man, with such experience gained in another locality and under different management, is very likely to have ideas of his own about railroading and will not so readily accommodate himself to the ways of his new employer, if there be any essential difference in methods.

The official who selects trainmen should also be competent to instruct in every feature of the work. This means that he must to a certain degree have a knowledge of the workings of the claim department, and between his office and that department there should exist the most friendly and cordial relations together with a thorough understanding of methods. In fact, there should exist the friendliest possible relation between all of the various departments of a successful system and this same feeling and principle should be imparted to and absorbed in turn by the trainmen.

THE FIRST INSTRUCTION

As a part of the first instruction given an applicant should be the information that accidents are to be expected; that the officials realize that at times they are unavoidable. He should be made to understand that he and his associate on the car are operating a large and dangerous machine over streets whereon are thousands of other vehicles and that the safety of life and limb of the passengers is dependent every moment upon their skill and fidelity to duty. Their manhood should be appealed to by impressing upon them a sense of the responsibility of their work and the importance of ever being alert and vigilant. However, they should be made to understand that the officials realize that with the greatest care on their part accidents are ever likely to and will sometimes happen, without any fault of theirs, and no blame will attach to them unless they are culpably negligent. Should an accident occur from any cause it should be reported honestly and fully and the names of all possible witnesses secured. The instruction should be sufficiently comprehensive to disclose the reason for and the importance of the report and witnesses. The trainmen should be made to realize that to the traveling public they are the company, that what they do in the course of their employment is the act of the company. Instruction with relation to accidents should be imparted in such a way that effort will constantly be made to avoid them not because of fear of reprimand or dismissal, but because of absolute loyalty to the employer.

The first effect of fear for consequence of an accident is felt in the claim department in the form of unreported claims, which have ever been the bane of the claim agent's existence. They come like a stab in the dark from a dagger in an unseen hand and from the wound thus made there is often a copious flow of the treasury's blood. I realize that at times, because of apparently wilful violation of well established regulations, it would seem necessary for purposes of discipline and example to discharge an employee; yet in discussing this matter from the viewpoint of the claim department it has long been a question with me if it is advisable to dispense with the services of an experienced man because of an accident. The right sort of man will hardly have the same accident twice, and the hazard of training a new man involves not only his likelihood to have the same sort of accident the other man had, but a thousand others as well of which his lack of experience affords him no knowledge. This is important as affecting the instruction the trainman is to have along other lines than that of imparting fear of dismissal for accidents. He should be taught to expect them always and be ever alert to avoid them.

THE ACCIDENT REPORT

The accident report itself should be sufficiently comprehensive to elicit, by its interrogatories, an explanation of every important phase of the occurrence, couched in plain, simple language and containing no more questions than are necessary to a clear understanding of the essential details. Before a man is permitted to "turn in" for work he should be required to make out an accident report under the tutelage of the employing official or some one in the claim department, and the instructor should be satisfied the trainman understands not only the report in all its details but the reason therefor as well. It should be made plain to him that the report is not only to furnish to his foreman or superintendent knowledge that he had the accident, but that in making it out properly and in securing all the witnesses possible he is in fact laying the foundation of the evidence for defense of a damage suit. He should be impressed with the idea that a lawsuit is not only the possibility but the probability of every accident and that it is incumbent upon him, whether motorman or conductor, to do all in his power at its inception to get the case in proper form for a successful defense; that the very first and most valuable effort in this connection is an intelligent, complete and honest report with witnesses. If the accident be one for which he feels himself to blame it is necessary to report it just as fully and get witnesses that the company might know at the earliest possible moment with certainty of its liability and get out of the difficulty as early and easily as possible.

Of course, to the new applicant there is so much instruction given that it is sure to prove confusing, and the necessity of following up the work is apparent. Some one has said that the greatest inheritance a boy can have is a good father. I might paraphrase this and say that in my judgment the greatest boon to the right-thinking trainman is good and intelligent superiors, especially superintendent and supervisors.

It has frequently been advocated that the claim department, by oral or printed means, should furnish instructions to the trainmen. I rather incline to the opinion that the instruction in what is desirable from the claim department's standpoint should be given to the superintendents and by them imparted to their men along with the instructions in regard to other requirements of the service. The superintendents should be thoroughly informed and be impressed with the importance of the instruction from the claim department viewpoint and not slight that feature of it. The

superintendent should know his men. He should read every accident report before it goes to the claim department and its defects, if any, should be called to the attention of the trainmen and they be instructed how to correct them. When a new man is put to work he should be called to the superintendent's office every two or three days for a considerable period and questioned about his experience and, in the light of that, again instructed in detail with reference to the things he has already been told about by the employing official but much of which perhaps has by this time escaped him or its application had not been properly appreciated. In this way the instruction will serve the purpose of teaching the beginner how to avoid accidents as well as how to take care of one when it happens. If started properly and taught to avoid accidents rather than to fear punishment for them, the trainman usually continues in that manner, especially if talked to occasionally and brought into personal contact with his superintendent, whom he learns to know and respect for the interest he sees manifested in him.

The superintendent should be in close touch with the claim department and its work and be quick to note and follow any change in its methods. Between his department and the claim department there should also exist the most cordial and friendly relations, and the work of both departments should be conducted, as indeed they are, as part and parcel of the same institution. The successful operation of one should not result in a disparagement of the other.

CONCLUSION

In conclusion, I should say that a selection of trainmen should be by an official especially adapted to that work, who should impart the first instruction in all branches of the service. He should devote his whole time to the task, see that suitable records are kept and in a way maintain general supervision over the trainmen. The claim department should furnish all necessary information to this official and to the superintendent, the latter to continue the work of instruction when the trainman is sent to his division. The claim agent should be in frequent consultation with the officials of the operating department and all information should be accorded them. I feel, however, that the best results can be accomplished in obtaining complete and intelligent accident reports by a more thorough education of the superintendent in all that is needed therefor, and that information thus acquired by him should be continuously, insistently and persistently communicated by him to the trainmen.

THE PREVENTION OF ACCIDENTS

BY ELLIS C. CARPENTER, CLAIM ADJUSTER INDIANA UNION TRACTION COMPANY

Reflect for a moment and see what a field broadens before you. There is no limit to its possibilities; its paths are many, with numerous fingerboards pointing to lands of promise. Go where you will, problems and possibilities will be found which will warrant your best efforts.

INCREASE OF INTEREST OF EMPLOYEES

(a) *"What can be done to increase the interest of employees of all departments in the work?"*

Do accidents affect all departments?

Can we interest the employees of each department?

Let us see.

In order to make it possible to have accidents on a railroad or electric line, we must first provide the means for them to occur. Accidents do not "happen," they "occur."

The superintendent in charge of this department should realize the advantage of good organization. He should select carefully his division engineers, bridge and section foremen, section men and others under his control. In conferences with his division engineers, he should outline the importance of careful inspection at stated intervals of every foot of track in the system. Special work, curves and all places subjected to extra wear and hazard should have more frequent inspection. Materials to be used must receive close attention before being placed in use. Defective parts should be cast aside and never used and worn portions replaced before the danger point is reached if safety is to be the watchword.

The division engineers, in turn, should meet with their section foremen and other subordinates, covering the same points in the way to impress best upon them the importance of each man feeling the individual responsibility necessary for him to strive to make his work the best and safest. A friendly rivalry among section foremen will increase interest and bring good results.

Many a car has been derailed or overturned at a curve where the rails have spread on account of spikes failing to hold in ties that were left in a little too long, when a few new ties, properly spaced, would have made the curve perfectly safe. Every tie, every spike, every bolt—in fact, all materials—as they pass the eye of the men who are to use them in the places for which they are intended should undergo this last and most important inspection. The men must realize that they share in the responsibility for the proper use of these materials.

With the track and roadway in proper condition, guarded by zealous gangs of men who have faith in their superiors, each one realizing that he is an important factor upon whom a share of the responsibility rests, we have taken a long step in the prevention of accidents.

MOTIVE POWER DEPARTMENT

The proper construction and maintenance of the rolling stock is vital in the proposition of preventing accidents.

Do your machinists realize that if a defect is found in material attention must be called to it at once and before it is placed in service? A slight defect in a flange, discovered while truing, may if the wheel is put in service cause a serious wreck. Inspect; report; do not take a chance. If material is unsafe, scrap it.

Do your carpenters realize that with every joint made, and every nail driven, should go the best effort of the workman? No job is done until it is well done.

Do your blacksmiths understand, as they form a weld, that upon that very weld may rest the responsibility of a collision or the prevention of one? The smith whose welds withstand the strain is the one in whom there is placed most confidence.

Do your inspectors care whether a car is in safe condition, or will they pass it with "I guess it will do for another day, if everything goes right"? Which kind of inspectors do you want?

For all of the various avenues leading to trouble the superintendent of motive power should sound a warning, either directly or through his foreman. So instill in the minds of the workmen that care and attention to details are necessary that each may be impressed that his work is just as important as the work of any other. Thus, when a job is completed it will embody the very best that is in the workman and bear the very impression of the souls of its builders.

POWER AND ELECTRICAL EQUIPMENT

In the production and distribution of the electric current much machinery and labor are required. Careful instruction of the employees of each class of labor is necessary. Each should understand the duties and dangers incident to his employment. No green hand or unskilled workman should be taken from one class of employment and placed in one more hazardous until he has been instructed as to the dangers and requirements of the new place.

I have thought that the very nature of the work of linemen tends to the reckless. They become so accustomed to the dangers that they fail to give full credit to what may happen to innocent persons. Linemen usually are expected to do their work with much dispatch. They go to trolley

breaks with horses on the run, and in their anxiety to get cars going they are apt to overlook placing proper safeguards so the innocent bystander and persons passing will not get tangled up with a live wire. Their familiarity with the dangers of a live wire should cause them never to leave a low hanging wire or an unsafe condition. These places should be guarded as they would if they were expecting their own wives or children to be kept from danger.

Carefulness and caution must be instilled into all of his employees by the head of the power and electrical department.

TRANSPORTATION DEPARTMENT

In the selection of men for train service, as well as the employees of the other departments, the steam roads have the advantage of the electric systems; they have been engaged in their business long enough for the sons and grandsons of men employed in the various departments of the service to grow up surrounded by an atmosphere impregnated with the railroad spirit. It is not so with the employees of the electric systems. Many a motorman and conductor has taken his car with only a few weeks' training, having absorbed what he could while being "tried out" or "broken in." Systems have developed so rapidly, and the demand for competent motormen and conductors has been so great, that it has been next to impossible to supply its needs. For this reason a great responsibility rests upon the man who passes upon the applicants for the positions of motormen and conductors. He should be quick to discern the qualities necessary for each. Seldom is a man fitted for both ends of a car. A man with the qualifications required in a motorman will not make an equally good conductor, and vice versa.

By far the greater number of accidents on electric lines are directly traceable to some act of a trainman, or come directly to his notice for immediate attention. If we are to enlist the trainmen in the campaign to prevent accidents, we must keep before them the seriousness of the accident features and many of the results thereof.

It behooves the management to see that close inquiry is made concerning the ability, integrity, personal habits and environments of all applicants for motormen and conductors; and that they are thoroughly instructed not only with reference to the proper handling of the equipment, but as to what to do to prevent and how to handle accidents from the standpoint of the claim department. Each applicant should be required to pass a written examination touching matters relating to accidents.

Occasional talks to the men, where they, too, may have the opportunity of giving their views upon the matters under discussion, should be had. Many good suggestions will be made by them.

By meeting with the trainmen, talking over with them the problems that confront us, taking them into our confidence, instilling in them a spirit of carefulness, co-operation and loyalty, we will get splendid results.

(b) *"The best means of promoting greater caution on the part of platform men."*

I would suggest taking these men into the confidence of the claim department. Keep close to them, through personal contact, meetings, entertainment, bulletins, etc. Show these men the large expenditure incident to accidents; the cripples who have to fight life's battles under adverse conditions; the widows and children who mourn the loss of loved relatives; all because some motorman "forgot" his order and was not attending strictly to business.

Men respond to proper appeals. Do not be too ready to criticise. Hear both sides of a question before passing judgment. Let the men understand that where they are right you will fight for them; that where they are wrong you cannot protect them. Stimulate in the platform men the desire to save every accident possible.

Many boarding or alighting accidents may be prevented if the conductor will shout a warning, block the way of the passenger about to alight and not open the door on the pay-as-you-enter cars until the car stops.

Keep the men posted by bulletin or circular letter on general results. Keep them interested by asking for suggestions for lessening accidents. Indicate from time to time how certain classes of accidents may be avoided. All will have a tendency to better the service, as well as to reduce accidents.

AUDITING AND TREASURY DEPARTMENTS

The work of the auditing department will decrease in proportion as accidents and troubles decrease. By a careful checking of baggage reports, preserving and filing for reference all daily reports of trainmen, the auditing department can materially assist in preserving important records and data for use by the claim department when needed.

Upon the treasurer the effect will be more noticeable in proportion as the percentage of the gross receipts necessary to meet the requirements of the claim department decreases, and you will discover his smile broadening as he greets you with a glad hand.

CLAIM DEPARTMENT

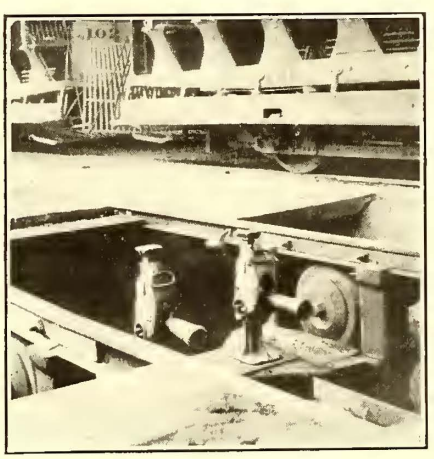
See that all of the other departments are permeated with the desire to prevent accidents.

Reduce your litigation and expenditures to a minimum.

Spend your leisure time at home with the baby, enjoying the rest made possible by the prevention of accidents.

WHEEL GRINDER AT SALT LAKE CITY

An effective method of wheel grinding without removing the wheel or axle from the motor is in use at the repair shops of the Utah Light & Railway Company, at Salt Lake City. The work is handled by a pair of emery wheels mounted on a frame set in a pit and belt-driven from an old motor, the rails immediately above the grinders being sectionized. The scheme of operation is as follows: A car is run into the house over the pit and the body is jacked up sufficiently to take the weight off the motor. The rail sections are then removed, the grinders raised to the wheel peripheries, and the motor is disconnected from the cast grid resistance beneath the car and connected with a water-barrel rheostat in the pit. The motor and car wheels are then run on the first notch of the controller, the grinder being run by its motor in the opposite direction. In this way the wheel can be ground in from twenty minutes to two hours, according to the conditions, whereas formerly the company had to take off the wheel and throw it away when the tread reached an unsatisfactory condition. A blower is provided in the pit and driven off the grinder shaft, to remove the dust caused by the grinding and throw it out of doors through a discharge pipe. All new wheels are ground to a true circumference by the company, with the result that the life is greatly increased and the troubles from flats reduced.



Pit Grinder

The Bay State Street Railway had an interesting exhibit at the Chamber of Commerce Industrial Exposition in the Mechanics' Building, Boston, Mass. One of the features was a special plat of its lines.

Physical Valuations

The Author Discusses the Services Rendered by the Promoter, the Ways in Which Profits in Public Service Enterprises Have Been Limited, and Some Merits of Watered Stock

BY O. T. CROSBY, PRESIDENT WILMINGTON & PHILADELPHIA TRACTION COMPANY, WILMINGTON, DEL.

You have been told in able papers heretofore presented how to make a physical valuation of a public utility property. It remains that now we need consider only this—why make a physical valuation of these properties? Is any good purpose served thereby? And we may also consider the almost identical question, When shall a physical valuation be made? The inquiry may be further subdivided; who is interested in physical valuation—stockholders or creditors, or the general public, or all these?

We must weary a little those who are impatient with rigorous definitions by pointing out that the term "physical value" may have two widely different meanings, leading to much confusion of argument, unless agreement at the outset be clear as to the exclusion of one or the other of these two meanings. Thus, shall we, or shall we not, include the cost of the several possible rebuildings of a given plant? Or is replacement value the true and only physical value? Merely for the sake of clarity let us in this discussion take the words in the former sense. When we thus include the honest and riskful expenditures for things that were good in their day and were then thrown away, we might well use the term moral value instead of physical value. He who would treat the early risks of capital as though they never existed is a repudiator and a kill-thrift.

INVESTMENT IN AN EXISTING PROPERTY

So far as the interests of the investors are concerned a sharp distinction exists between the case of a new enterprise and an old one as to whether or not strict attention need be paid to the physical (or moral) value of the thing that is to operate. Thus, if a long-established property, having a known and relatively stable earning capacity, should go into the market for $1,000,000 or $5,000,000, the money would be lent (or otherwise invested) chiefly on the basis of the known earning capacity and a reasonable assurance that the new funds are to go to the betterments, not to be wasted.

It would not be very important to go at length into the question of the replacement value of the property as it exists at the moment or closely to investigate the past with a view to determine how much money may have been spent on what is now the scrap heap. A going concern, by presumption, has sufficient plant to earn so much net profit. Additional funds are required for some specific purpose which, at worst, cannot be thought to diminish and in fact will probably increase this net profit. A given factor of safety satisfies the investor. This factor of safety must always rest upon earning capacity and can never be guaranteed by the mere brutal fact that such a sum of money has been spent. One dollar wisely spent and wisely managed may earn many times more than $2 in the hands of fools.

INVESTMENT IN A NEW ENTERPRISE

In a new enterprise, however, the investor wants to know, as nearly as possible, the real cost of the venture. He wants to know how much profit is probably to be had in order to determine the degree of his risk and to settle the terms of his partnership with the originators and administrators whose work alone (or whose work and capital) will be combined with his own capital. The necessary cost may of course include money paid for rights of various kinds which are "physical " only in an indirect way. But such rights as may be necessary to the use of physical property may be taken, for the purposes of the venture, as part of the material structure and, as your early papers show, the cost of such necessary rights generally is, and must be, considered as integral with the cost of iron or cement.

Both investors and administrators desire also to establish the costs of their material property in order to be furnished with a convenient formula for expressing an insidious and sometimes neglected element of operating expense. I mean the cost of depreciation. It is true that the formulas which express depreciation as a percentage of present physical value are often enough erroneous; yet they should not be discarded. They offer helpful suggestions. It is probable that in the long run they will be replaced by formulas based upon some unit of operative work, as upon a car-mile movement, rather than upon the mere cost of material constituting the operating system. Naturally we shall not have a perfectly accurate expression without including an impossible number of factors. The task need not here be essayed. We, and our allied financiers, have recently been keener about the matter of depreciation than heretofore.

WHAT CONSTITUTES INVESTMENT?

The relation which is now most puzzling—which in some cases is almost baffling—springs from the fact that a street railway is not a private enterprise so far as its conduct is concerned, though it is strictly private from the point of view that money invested in it is wholly risked by the investor. It is this relation which I shall to-day endeavor to analyze. From this point of view the question of physical valuations becomes the whole question of our fiscal relations to the State. We must now ask ourselves, "For what purpose are various commissions seeking to establish replacement values?" And out of this flows the general question, "What treatment are we to expect in all respects from the public authorities?" It is this large aspect of the matter which shall control my remarks to-day.

The present status is abnormal and necessarily temporary. It cannot be permanent. In effect the public now says to the investor in a public utility: "You shall operate your investment as I may determine. I refuse to guarantee any return on your money, but I shall fix at my will and from time to time as suits my pleasure the percentage of profit which may be declared on——" On what? On the whole investment, including past and gone experiments? Or on replacement value? Or on outstanding securities? The utter confusion in which the subject lies may be best understood by referring to the decisions which have been given in cases not controlled by a rate fixed in the basic contract (or charter) of the public utility. It has actually been necessary to go to the courts to obtain a ruling that the rate-fixing power shall not be used to confiscate a threatened investment. The courts, in some well-known cases, have gone further and stated that rates should, if possible, be maintained at such figures as would give a so-called reasonable return on the capital invested. Whether, in such rule of so-called reason, there should be taken into account years of no dividend in the past with a view to giving some so-called "reasonable" return on an average of many years and whether or not experimental expenses and party replacements are to be always taken into account—as to these important questions we have no clear rule.

Legislators are groping, many of them in an honest en-

*Abstract of paper read before the American Electric Railway Association, Atlantic City, Oct. 9-13, 1911.

deavor to be fair; others are groping only to do the thing that will be popular at the next election. Commissioners are embarrassed by the possession of vague powers. If they go too far the courts may check them; if they go not far enough the public, necessarily ignorant of the specific rights of corporations, will demand prosecution which may rapidly deteriorate into persecution. And investors are groping.

INDEFINITE FRANCHISES

The trouble arises from the fact that at the very beginning of public utility enterprises the bargains made with the public were not sufficiently definite. All who have had experience in working over a European concession will remember how at first the American, accustomed to the quick and easy-going methods that were in vogue twenty years ago, rather shies at the long, precise and apparently embarrassing provisions which go to make up a contract with the public authorities. Some of us would be glad now to be able to fall back on anything specific rather than to be buffeted by the caprice of official guesses as to what sort of returns should be permitted to money ventured in the public service. Even in Europe, however, there has not been any very general settlement of the question as to just what the public is willing to permit in the way of profit to private money invested in public utilities. If there were no limit expressed in the rate of dividend or imposed by way of fixing rates the subject, of course, would scarcely need treatment. And it was this point of view which prevailed among many who went into public utilities thirty or forty years ago. It may be taken as perfectly certain that few of these enterprises would have attracted a dollar of capital if it had been known that the implied ratemaking power of the State would be afterward used to limit the returns of capital thus invested to 6 per cent or 7 per cent or 8 per cent or 10 per cent.

Every one over forty can remember when all these things went, only because a certain "hurrah" could be created and a hope of large profits held out to those who ventured their funds. That the public, through its officials and through the general assent of the whole body of people and through the known advertisement of such stock when presented for subscription, became a party to this theory cannot well be doubted.

Of course it is now easy to state that everybody must have known that there exists always, and must exist always, in the State the power to fix rates so that a "reasonable" return (and perhaps only a reasonable return) should be allowed to capital. But such was not the theory then. That this is evident is due to the facts above mentioned and the further fact that, in order that such a theory should have any practical application, it must be determined as to whether the implied limitation of dividend shall be on replacement value fixed at any particular time or on the total investment, much of which may have been lost. And it would also be necessary to determine whether or not an average or an occasional dividend was contemplated. With rare exception we know full well that this subject was not so much as broached in the charters out of which were born a great majority of the public utilities of this country. Furthermore—and this is very important—it would be necessary to express a rule to guide in condemnation proceedings or to guide in the liquidation at the end of a fixed-period franchise. We all know that the State may take the hats off our heads, provided a due compensation be made. But that due compensation should not be a matter of *ex post facto* judicial determination. Let us know beforehand whether earning capacity or physical value only shall be considered. Investors therefore are entitled to say, "If there was an implied limitation, what was it, exactly? At least, what were its elements?" To this question there is as yet no answer.

RATE MAKING AND REPUDIATION

If, therefore, the rate-making power be now so employed as to make an extremely narrow possibility of profit it is a very plain case of repudiation. The word is an ugly one, but I use it advisedly. At the same time I use it quite without bitterness and with full recognition of the fact that no State can exist without occasionally exercising the sacred right of repudiation.

Every conquest over wrong has been made by repudiating "recognized rights" that have degenerated into wrong. The French Revolution was a bloody repudiation of rights that had been fully acknowledged for 1000 years. But the word is ugly because it represents a kind of act that should be done even by the State only in the direst necessity. If a supreme and sovereign remedy, as that of electrocution or repudiation, be too commonly applied, then madness lies that way.

LIMITATION OF PROFIT AND RATES IN NEW FRANCHISES

We can avoid even the probable necessity for such an act in respect to new franchises if we but clarify some of the doubtful points about which so much contention is now raging. Let us suppose that the public, you and I and John Smith, make up our minds that we shall not permit more than 20 per cent profit to be made as an average return to the cash investment made in a public utility. Let us say that when this point is reached operative companies must recognize our partnership in the enterprise by diminishing rates, but that while working within this allowed limit an operative company shall be left to carry the burden of working out the best way of producing traffic..

It goes without saying that this becomes at once a permanent rate regulation. It also goes without saying that few enterprises would be found making such a profit, even when allowed. And it again goes without saying that it will often be easier to make 10 per cent or 20 per cent by having a relatively low rate rather than a relatively high rate. The electric light company which might to-day try to charge 25 cents per kw-hour, if permitted to do so, or the ordinary street railway company which should try to charge a 15-cent fare, if permitted to do so, would, in both cases, become heavy losers and wind up as bankrupts without any assistance from the public commissions.

What would be secured by this limitation would be this, that only a certain maximum rate, found to give most nearly the maximum return on the investment within the agreed limit, would ever be charged by the operating company.

It should be borne in mind that any such limitation at once differentiates a public utility investment from a private investment. There it is not 20 per cent, but 2000 per cent or 20,000 per cent which is the possible return on the investment.

REASONABLE RETURN

It would be probable, however, that, in spite of a limitation at some such figure as that suggested, a sufficient amount of money could be obtained to make the needed development of public utilities. Indeed, it may safely be stated that the promoter who endeavors to borrow, in the usual classical way, all the money required for his project in the shape of a bond issue, will be able to get the money, other things being equal, if he can demonstrate to bankers the high probability that his enterprise will earn say three times the interest charges on the actual cash invested.

Fifteen per cent to 20 per cent may seem a high margin for those who have not tried this very often, but when it is remembered that it is the fashion for bond houses to require a showing from established companies of at least twice the bond interest in net earnings it will be seen that the relative conservatism of to-day would probably demand of an entirely new venture estimates indicating a good deal higher earning capacity than two to one over the bond interest. This is quite reasonable, since estimates, after all, are only estimates. Hopes are only hopes. But bond interest is hard cash. It will not be necessary on

this occasion, however, to sharpen our pencils in an endeavor to fix exactly what would be an inviting rate to cover cases of entirely new ventures.

I want particularly to urge, however, that we should always and always cry out for something *definite,* something precise in regard to limitations which the public desires to place upon the earning capacity of money invested in public utilities. This limitation should then be further defined as to whether or not it shall cover honest mistakes of the pioneer in regard to the purchase of plant and that necessary obsolescence which must be faced, even if the highest wisdom be used in plant purchase. Let us once for all have a definition in our charters of "physical valuation" in that sense; let us find out what this yardstick of "physical valuation" is intended to measure. It is not improbable that in clarifying this subject it would be quite reasonable to establish a different percentage of return for money going into new ventures as compared to that which goes to increase an existing or prosperous public utility.

The public is, of course, a partner with the investor and administrator of every public utility. If by its growth it has given a firm establishment to the outstanding securities of a given concern, if those securities have earned 5 per cent or 6 per cent on their average market valuation during say the preceding four or five years, then the partnership interest of the public may express itself by limiting additional profits to such amounts as are necessary to assure only a comfortable margin beyond the payment of 5 per cent on all fresh capital required for extensions and betterments.

REPUDIATION INVOLVED IN LIMITING RETURN

I am aware that there is some suggestion of repudiation from the point of view above indicated, even in such treatment of such existing companies, but the practical wrong done would not be great if the market value during the four or five years previous to any new regulation should be taken account of when dealing with outstanding stock and on the average of such value should be placed a limit of future stock dividend.

It might be questioned that such a rule could be constitutionally applied. As a matter of fact it would not be, in legal effect, different from the rate regulation that is now resorted to in all such cases. It would be, in fact, a rate regulation applied with far greater simplicity than is now done through the various commissions operating in this country.

And it is not improbable that numerous companies would be glad to waive any technical objection which they may be able to set up to the fixation of such definite limits in order to be free from the vexatious inquiries and valueless determinations which must be made in the effort of society to exercise its share of the partnership if that exercise be done only by the present methods.

METHODS OF LIMITING RETURN

I need not remind you of the fact that endeavors will be made to extend transfer privileges which may mean a substantial lowering of rate. There will also be endeavors made to extend the length of ride covered by the charter rate of fare and there will be endeavors made to impose construction charges of various sorts on street railway companies, all of which endeavors will be in the end, when successful, of like effect as if the traditional 5-cent piece which should be rendered unto Cæsar were clipped to 4 cents or 3 cents.

Many theoretical rights of difficult application might be traded off with advantage to us and to the public for some perfectly definite understanding with the public in respect to our possible profits. And if, in fact, no great progress be made toward an actual and formal redrafting of contract relations with the public we may the more successfully resist some of the unjust attacks which will be made against us if by constant public discussion and occasional formal adoptions of definite rules there shall be finally established a tradition more just and more definite than that which now surrounds the subject when it reaches the court.

We should also have in mind the fact that in some cases even those charter rights in respect to fares which have been accepted for years as indisputable may be challenged and by some unexpected judicial inspiration perhaps actually set aside. The possibility of finding ourselves in the position of utilities whose rates are now subject to regulation requires us to familiarize ourselves with conditions that would then have to be met. We have also to consider that a number of street railway franchises are of limited duration, expirations are occurring from time to time, and at times conditions become so embroiled that it is found best on both sides to take out a new charter if the old be not definitely ended.

We should, therefore, from every point of view, be prepared with some fairly definite ideas as to what would be a proper relation to establish between a public utility and the public. This is best had by considering a new case. Let the modification and the complications arising in the older case be set aside, and let us remember that they can be the more readily solved if we agree upon some ideal relations which would govern a new case.

PERMISSIBLE PROFITS IN NEW COMPANIES

As indicated above, I should consider that a definite statement of the allowed average percentage of profit should be one of the fixed elements of the contract and the thing upon which that profit is to be calculated should be definitely stated. Such an agreement in regard to a limiting profit, it must always be pointed out, is, in fact, a substantial rate regulation, free from the petty complexities surrounding the effort to regulate rates by those who cannot possibly have the familiarity with them which comes only through the experiences of operation.

Let our stand be this, that men will not work as men must work in public utility ventures without the expectation of liberal rewards; that we prefer to have the upper limit of these rewards made definite rather than to be continually in contention with public authorities because they are indefinite and, before giving up the convenience of the modern share capital company with bonus stocks, let us demand that something better shall be contrived by virtue of which it will be possible, as it will also be desirable, to represent capital in any capacity either separately or combined. And if finally the public rules against liberal rewards, and also against convenient methods for their distribution, let all of us, as citizens, recognize that such ruling must inevitably result in making the strong stronger, the weak weaker. Every new construction must then be but an extension of an old and prosperous company.

In a rigid régime of 6 per cent there is no place for the daring promoter who risks all to gain or lose much. And I venture to say that when his voice shall no more be heard in the land many there will be to deplore his departure. Good and bad he is, like prophets and presidents, like winds and waves, like dogs and drinks, but in the main, whether dreaming a transcontinental line or a modest intervillage trolley, he is a true empire builder, personification of the hope and vigor of our race. He is the Ponce de Leon of commercial progress. He ventures into a thousand hardships, makes a thousand discoveries, while seeking a perennial spring whence shall flow rejuvenating streams watering the stock born of his undying hope and his prophetic vision. The source of the stream indeed is ours, but 'tis he who discovers it. Let him bottle it legally; let him sell it under the pure-food law, specifying its contents—giving a statement of what is in it. He can then go to a person and say: "There you are; there are the facts. This paper represents money. This paper represents work." And, after all, what is capital but the fruit of work performed yesterday? Let the work of to-day and to-morrow also be watered into fruit.

Overhead Charges*

A Discussion of the Elements of Value of a Non-Physical Nature Which Are Properly Included in the Appraisal of a Public Utility Property

BY PROF. MORTIMER E. COOLEY, DEAN OF THE UNIVERSITY OF MICHIGAN

In the valuation of the property of public service corporations aggregating $1,100,000,000, I have had the honor to serve both the public and the corporation. By far the greater part of my work along these lines has been done for the public; and having in the beginning and for about seven years worked exclusively for the public I naturally approached the problems from the side of the public and, it might be said, as against the corporation. It very soon became apparent, however, that either the contentions of the corporation were sadly at variance with the facts or the public was densely ignorant of the true state of affairs; and henceforth the real problem was to discover as nearly as might be the common ground upon which there could be no serious disagreement.

It must be said at the outset that the responsibility for misunderstanding rested largely if not wholly with the corporations. Their business is of a technical character and not readily understood by the layman without explanation, and the corporation official had not in the past felt called upon to make explanations, at least not of the kind inspiring confidence in the public mind. This is now seen to be true, and while not too late for correction the failure to comprehend its importance, even its necessity, at an earlier date has led to the very serious controversies of today, wars they might be called, between the public and the public service corporation. The public is fighting for what it honestly believes its rights and the public service corporation is fighting for existence.

Setting aside the mistake which has been made in the past of keeping the affairs of the corporation in a sealed book, any fair-minded man who will make a study of the problem with all the information now available must inevitably reach the conclusion that the present attitude of the public toward the public service corporation is as much at fault and quite as blamable as was the secretiveness of the corporations in the past. The public, slow to wrath, is a mighty force when once aroused and can no more be resisted than the ocean tide. It, however, reaches its height and begins to ebb in due course, and it remains to be seen whether in the future we shall profit by the experience we are now having and establish conditions far more stable, so stable in fact that a similar situation cannot again arise. Much swifter progress could be made in bringing the war to an end if the fight could be carried on by the master minds on both sides. History reveals that unfortunately that is not the way wars are conducted. Politics has prolonged many a war and delayed the re-establishment of peaceful conditions after the war itself was ended. The political charlatan thrives at such times and seeks to maintain the conditions necessary to his nefarious existence. But he is not the only parasite; there is also the unprincipled expert, scientific expert he calls himself, whose expertness lies in being able to set up an array of figures in apparent proof of any result desired or required of him by his boss. If anything he is more dangerous than his boss, because his weapons are figures juggled to suit his purpose, and only to be refuted by an expert on the other side, who, however honest he may be, is sure to be considered by the partisan equally unprincipled.

OPPORTUNITY FOR THE ACCOUNTANTS AND ENGINEERS

The real forces effective to end this conflict between the public and the public service corporation are the accountants and the engineers—not to end it, perhaps, but to point the way so that the man who really desires to be fair may have before him the facts upon which to base his judgment. The public as a whole is honest and fair—it is only individuals who are dishonest and unfair—and once the ignorance of the public has been dispelled the true and correct solution will be in sight. But the engineer and the accountant, while in the main honest enough, are not to escape responsibility in some measure for their ignorance.

The engineer has not always dared to tell the whole truth, fearing it would not be believed, and that his reputation would thereby suffer. He has therefore told but a part of the truth, and now when the necessity for the whole truth is imperative his task is much increased, he being obliged to explain his earlier position. In many, and it is to be hoped in most, cases this earlier position of the engineer was due to ignorance of the real facts, or more likely to knowledge of only a part of the facts. It is only comparatively recently that the engineer has been called upon to work with the accountant and the financier in the development of all the facts in the creation of the property of a public utility corporation. Is it therefore to be wondered at that the public has remained in ignorance?

The accountant's share of the responsibility cannot be said to be due to ignorance or to any fear that his reputation might suffer from a disclosure of all the facts. It is repugnant to the average mind to wrestle with the mass of figures required in setting up the details of accounts. It should be possible for the man of average intelligence to enter an account and find there the essential things required in comprehending the cost and the value of a property and the expenses of operating and maintaining it. It should not be necessary for an expert accountant to spend months digging through accounts for the necessary data upon which to base costs and values. This criticism does not bear today with the force it did in earlier years, because of the study and effort on the part of accountants for a number of years past to devise methods or systems of accounting which will afford almost at a glance any particular kind of information desired. The accountant has rather been the custodian of facts, the keeper of the storehouse as it were, but now he must perform the additional task of preparing the facts for consumption. The facts required by the public at this time are in themselves simple enough; the difficulty lies in devising means to disclose them so that they can be easily comprehended.

APPRAISALS OF PROPERTY

The public desiring to inform itself as to the cost and value of a public utility property requires an appraisal to be made, that being the simple and obvious way to go about it. Prior to 1900 the principal appraisals of this class of property were of water-works. In practically all cases this investigation was made to discover the *value* of the plant with a view to taking it over from private to municipal ownership, the condition for the transfer being usually set up in the franchise. These appraisals were usually made by engineers, it being customary for the municipality and the company each to choose one or two and these to choose another who should act as chairman and cast the deciding vote in case of a tie. All too frequently the appraisers entered upon their work as advocates, each for the side choosing him, and the appraisal became a controversy,

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which had finally to be settled in the courts. The decisions handed down have become the law of the land which, while almost wonderfully good in the majority of cases, is not altogether applicable as precedents to many of the cases arising to-day.

The chief object in those days was to arrive at the value of the property, which included the so-called "going value" of the property. "Goodwill" was another element considered. But to-day, and since 1900, appraisals are made not alone to discover the value of the property, but the cost as well. The appraisal to-day is not so much for the purpose of transferring the property from private to municipal ownership, although that is the alleged object in a few cases, but for the purpose of taxation and rate making and to determine the extent to which the issuance of securities can be authorized. Obviously it is to the interest of the corporation to have a low value for taxation and a high cost for rate making and the issuance of securities. But of course both cannot be had except as the facts justify them. And right there is the first obstacle encountered by the public and the corporation in coming to an understanding. The public fails to see any difference between the cost and the value and argues, not without some show of reason, that if the property has a certain value for taxation it surely ought not to be different for rate making and the issuance of securities. The fact that the corporation fights to keep its figures down in the one case and up in the other no doubt contributes in no small degree to the attitude of the public toward it. It is, therefore, important to discover first if there can justly be any difference in the two cases and, second, if so, to what extent can such differences properly exist.

It is not so much my purpose in what follows to say what ought or ought not to be done as to indicate the things which must receive consideration in determining what ought or ought not to be done. The average individual thinks of the value of a public utility property as consisting merely of the things which can be found and inventoried; in other words, he thinks of the value as being made up of the physical elements only. For many it is quite a long step to add any intangible elements or to consider the capacity of the property to earn a return on the investment. The farmer, for instance, in placing a value on his land unconsciously considers how much of the different things can be raised, the first element of value being its earning capacity. Then he considers the physical structures, house, barns, fences, drainage equipment and stock and other things which he has had to add from time to time, and for which he has had to invest capital in one form or another. I venture to say that if a complete analysis of a farming property could be had, starting from the beginning, most if not all of the elements, or their equivalents, would be found the same as in a public utility property. The first thing, therefore, is to realize that the value of such a property does not lie in the physical elements alone, independent of their earning capacity.

POINT OF VIEW OF THE UTILITY

It aids materially in one's quickness of understanding to assume one's self to be the corporation and then to take the steps successively as they come in building up the property, putting it into operation and carrying it along until it becomes self-sustaining. One readily comprehends the outlay necessary to acquire the rails, the ties, the overhead work and the power plants and the labor involved in their installation. One does not, however, so readily comprehend the other outlays which, although they are not seen as tangible elements, are just as much present as the tangible elements themselves. These other outlays are in general grouped under the name of "overhead charges." The term is somewhat elastic; its scope will be greater or less, depending on the extent to which certain charges are considered as a part of the physical structure itself. For instance, the elements of contingencies and contractors' profits, if not included in the cost of the physical structure itself, would have to be considered as overhead charges; both are present and must appear in the cost somewhere. The practice of valuators is not uniform, some preferring to include those two items in the cost of the physical structure and others to separate them and add them as a percentage. Occasionally an appraisal has been made with no separate charge appearing to cover contractors' profits, but in such cases the unit costs have included them or the items have been taken from the contracts awarded on bids invited for the work. The contractor's bid includes, of course, both his allowance for contingencies and for profits.

A usual allowance for contractors' profits is 10 per cent on the cost of the work. The item of contingencies varies with the nature of the work. There should, indeed, be two items of contingencies, one a construction charge, the other an inventory charge. The former may vary in an inventory from 1 per cent to 2 per cent to as much as 20 per cent or 25 per cent. An example of a low percentage for this item might be found in the cost of a power unit the contract for which calls for the unit completely installed and operated for a time before acceptance, but in such a case the contract price includes a liberal charge for contingencies, as no contractor would think of undertaking the work without protecting himself against unforeseen expenses incident to such work. The same thing is true in the case of cars which are delivered on a contract. An example of the higher percentage may be found in a foundation or in a job of piping or station wiring. Making due allowance for varying conditions, an average charge of 5 per cent on the cost of all items to cover construction contingencies is as low as it is safe to go. In the same way and for similar reasons another 5 per cent should be added to cover inventory contingencies, making a total charge of 10 per cent for contingencies.

It has been frequently argued that little or no allowance should be made to cover omissions from the inventory, the reason given being that the work has been done and all the items can be found and listed. But such is not true in fact. When the costs were figured in the first place complete plans and specifications were available, and quantities could be taken off and the difficulties of construction studied in detail. In making the inventory almost always no plans and specifications are available and there can be no comprehensive study from the work as done which will lead to the results obtained from a study of the plans without a liberal allowance to cover contingencies. Indeed, it frequently has been found desirable if not necessary to recreate the plans from the work as done before undertaking to value the structure. Numerous instances might be cited to show that even a total of 10 per cent was an insufficient allowance to cover all kinds of contingencies. The use of a smaller percentage can be justified only when the unit costs have been determined from similar plants the actual costs of which were known, and in such cases the contingency item or a part of it will be found in the unit costs themselves. But even when the unit costs are such as to cover construction contingencies there remains the inventory contingency which must be added to complete the cost of the physical structure as it is listed in the inventory.

The charge for engineering likewise is a desirable item. Engineering usually covers the making of surveys, plans, specifications and estimates, inspection of materials and the supervision of actual construction work as it progresses. There should be added a charge for engineering in connection with each general item of the inventory which, depending on the nature of the work, may vary from 1 per cent to 2 per cent up to 10 per cent and even more. Then there should be added to the cost of construction a general item of 2 per cent or more to cover engineering not assignable to individual parts of the inventory. The total charge for engineering will in some localities not exceed 4 per cent or 5 per cent, but in other localities it will go much higher.

Many of the earlier appraisals went no further than to include the cost as determined from an inventory, to which was added an allowance for contingencies and engineering The depreciation of the physical elements due to wear and exposure to the elements was then determined usually by assigning to each element a life and considering its age at the time of the appraisal. The result thus obtained was called the physical value of the plant, and to this were added any "going value," if it could be determined, and sometimes another value, that of "good will." The appraisal was then considered complete. While such a value, an approximation at best, might have sufficed in the older days of liberal dividends and little or no scrutiny of the affairs of a corporation, it in no way meets the conditions as they exist in these days of public demand. The public service corporation is no longer free to do merely the things which its management considers advantageous to do from the standpoint of insuring dividends. It is compelled to do things which involved expenses of such variety and magnitude that in some cases not only are the profits reduced to a point of practically no dividends, but there are insufficient net earnings to pay the interest on the bonded debt. It is this condition of things which renders it all-important both for the public and the corporations that the elements of cost and of value in a public utility property be made perfectly clear. This is the great problem of the day and it is all-important in that it affects the life itself of the public utility. It is equally important whether the utility be owned and operated by a municipality or by a corporation. The public service corporation is but the agent or servant of the municipality, and what affects one must of course affect the other.

FULL UNDERSTANDING REQUIRED

The first thing necessary, therefore, for the man who would attempt to regulate the conduct of his agent or servant is to fully understand what is required of him. If a man has been successful in his own business it was due to careful study and a mastery of details. It passes comprehension that such a man should assume to direct or control a business about which he has but a smattering of real knowledge. If every man would apply or allow to be applied to a public utility the same principles which he applies to the conduct of his own affairs there would be little to complain of. What, then, are the things which the honest man should understand if he is to act wisely in the regulation of a public utility? Let that man put himself in the place of the public service corporation and see for himself the things it would be necessary to do. Imagine that he starts at the beginning. He is an active, perhaps a prominent, man in his community. He conceives that an electric street railway system would be a good thing for the community. He talks it over with some of his friends, the matter is carefully canvassed and the public sounded to discover whether there is any real demand for street cars. This may have taken several months, and required considerable time to be given to the project either by the man himself or some one employed for the purpose. Thus is a preliminary expense incurred.

It having been determined that a street car system is desirable in the interests of the public, its promoters must consider whether it would be desirable in the interests of the man who has money to invest. That is settled at once by the rate of return likely to be realized by the investment. Such a rate must be sufficiently attractive to divert money from other channels, and moreover the rate must be sufficient to meet any additional hazard not encountered in the ordinary channels of investment. A careful study must then be made of the routes, the necessary surveys and general plans worked out preparatory to obtaining a franchise. Thus a further item of expense is incurred. The franchise being obtained, it is necessary to obtain consent from property owners, which may be a very heavy item of expense. All of this work may have taken a year or several years It is the development period of the project and all items of expense legitimately incurred are proper elements of cost to be charged to the property. Such items of expense do not appear in the inventory of physical elements of a property, and they are therefore an overhead charge. The extent of this charge necessarily varies greatly with the locality. Property consents alone have been found in some localities to run as high as $2.50 per front foot; in such a case the preliminary or development charge might easily reach $20,000 or $30,000 per mile, which would represent a percentage quite beyond belief by the average man. It is not yet practicable in most cases to separate the item of the development period so as to discover whether it might fairly be represented by a percentage of the cost varying between any definite limits. This item is altogether too frequently ignored even by experienced appraisers; or if not ignored it is included in the item of organization expenses, which item also frequently includes legal expenses. When so included the combined items may vary from 2½ per cent to 5 per cent and more, depending on locality.

The items of insurance, both fire and casualty, are now quite generally recognized as proper charges, the amount varying usually from one-half of 1 per cent to 1 per cent.

Interest during construction curiously enough does not appear to have been thought of in the earlier days of appraisals, but the man of business knows without any argument that money cannot be borrowed without interest. The only question is on the time it should run. Six per cent is accepted ordinarily as the rate, and the time is one-half the construction period. If, therefore, the construction period be one year the rate would be 3 per cent of the total amount expended, assuming that the expenditures start from zero and mount uniformly to the total at the end of the year. The construction period in a street railway system is ordinarily taken as the time required to complete the power plant. This in a plant of any magnitude may be from two to three years. Along with interest the taxes must be included or set up separately, and it should not be forgotten that the interest item must also include the interest on the expenses incurred during the development period. Thus in a plant in a large city the interest charge might easily reach 9 per cent or 10 per cent.

THE EFFECT OF ELECTRIC RAILWAY OPERATION ON TAXABLE CITY PROPERTY*

BY PAUL WINSOR, CHIEF ENGINEER MOTIVE POWER & ROLLING STOCK, BOSTON ELEVATED RAILWAY

Electric railways are almost always built on one of two theories. The first is that the city in which they operate should be built up solidly and that the least mileage should be operated for the largest possible revenue, no extension being built until the company can foresee at least operating expenses and bond interest. This type of road increases the value of taxable property in the business part of the city materially, but does not assist much in the development of the city as a whole, particularly along attractive lines. It encourages high blocks, tenement houses and the accompanying drawbacks that these erections always bring.

The other policy is to build lines into new territory ahead of the population, thereby largely increasing the area available for homes and very greatly increasing the value of outside property. The electric railways of the city of Los Angeles have been managed in this second method. This policy has tended to equalize taxation by very greatly increasing the value of property which ordinarily is just outside the city limits and enjoys most of the advantages of a city without sharing its burdens.

Speaking of conditions in the city of Los Angeles, which

*Paper read at the convention of the American Electric Railway Association, Atlantic City, N. J.

I had the pleasure of visiting two years ago in company with your then president, Mr. Shaw, and a large number of other electric railway men from the East, there are cases there in which the assessed value of the property increased tenfold very soon after the construction of an electric line, and the opening of this undeveloped territory has given the laboring men an opportunity to purchase homes at reasonable prices. These homes are built on ample-sized lots, with lawns and gardens, and with plenty of fresh air for the children. The result has had a markedly beneficial effect upon the city's condition, in that where a man acquires his own home and becomes a taxpayer he naturally becomes interested in the welfare of that city, whereas in cities where tenement districts predominate unsatisfactory social conditions are usually found. What does the average man care about the upbuilding of a community in which he has no permanent interest? To some extent also these conditions are the solution of industrial freedom. It is much more difficult to persuade the laboring man owning his own home to join in strikes or to be led to destroy property.

Of the benefits derived by the city through increased valuation of property owing to street railway extensions, the city of Los Angeles affords a striking example. In a certain district in that city, the assessed value of the property before the railway extension was made was $120,000, whereas within three years after the railway company had extended its line into this territory the assessed valuation was raised to nearly $2,600,000. This certainly should show that electric railway facilities are very beneficial to taxable city property.

The first policy of railway construction, outlined in the first part of this paper, tends to immediate earning power for the company and consequent dividends. The effect of the second policy is to create a much more attractive city than could be possible in congested territory. The builder under the first system obtains a more immediate monetary benefit from his investment; the builder under the second system has the satisfaction of developing a larger property. The experience in the city of Los Angeles has been that the suburbs have developed rapidly; real estate in the central portion of the city has also increased in value but in a less marked degree.

CAR METERS IN CAPE TOWN

In a paper presented before the Institution of Civil Engineers, London, Eng., by Alfred Sharman Giles, on "Tramcar Meters and the Economical Results of Their Adoption on a Tramway System," the author described the benefits which had been obtained by installing recording wattmeters on the cars of the Cape Town tramway system.

From records taken over the tramway system prior to fitting all the cars with meters it was ascertained that the same car, driven under exactly similar conditions over the same route, showed a difference of 40 per cent in the amount of electrical energy used by one motorman and another. In order to determine the waste of electrical energy which may take place some tests were made on a portion of a route in Cape Town where in a distance of 4383 ft. the line rises 306 ft. The test car weighed 22,174 lb., and together with motormen and observers was reckoned for easy calculation as 9.9 tons. It was fitted with four recording instruments, namely, wattmeter, ammeter, voltmeter and speed indicator, the last three being specially arranged to pass 5 in. of chart per minute.

The car was driven up the hill without a stop, slowing down only on entering and leaving the three passing sidings and a 37-ft. curve. The energy used was 3.75 kw-hours. To illustrate the effect of passenger stops, the car was then driven up the hill, stopping at fixed halting places, each stop being made for five seconds. The energy consumed was then 4.25 kw-hours. The stopping, therefore, accounted for 11.76 per cent of the total energy required to run the car up this grade.

The effect of faulty starting and acceleration is shown in the following table:

	Faulty Start.	Correct Start.
Average power used, horse-power	84.3	74.1
Average loss in power, horse-power	10.2	...
Consumption, watt-hours	314	276
Energy wasted, per cent	14	...
Time to bring controller to full parallel, seconds	4	9
Maximum current, amperes	232	150
Pressure drop during acceleration, volts	85	65

It will be seen, therefore, that 14 per cent of the energy required for starting can be wasted by faulty acceleration.

The effect of the personal element in car operation was illustrated very well from some results obtained over the Wynberg section of the tramways. The energy consumed was averaged over one week for ten different motormen, when the figures ranged from a minimum of 1.2 kw-hours to 1.67 kw-hours per car mile.

About one and one-half years ago, in order to encourage economical operation, a bonus system was instituted for the motormen. It has met with some success, although there is room for still further improvement. For each section of the tramway system a reasonable kw-hour figure per car mile is fixed, and all men averaging this figure during the week receive a bonus of 2s. 6d. (60 cents). A careful log of the daily meter readings and mileage run is kept, together with the name of the motorman working the car. Two or more men may run the car during the day; the figures, mileage and meter readings are kept distinct, and at the end of the week are totaled up in the power-readings book. A list is posted each week showing the results of each man.

In Cape Town the installation of meters on all cars has had a marked effect on the power generated and the maintenance costs of the equipments. To take a few items, the average lives of various parts were increased as follows:

	Before Meters Were Adopted. Miles.	After Meters Were Installed. Miles.
Average life of armature bearings	23,450	33,766
Average life of motor pinions	27,883	31,916
Average life of axle bearings	58,750	92,333
Average life of car wheels	45,833	55,833
Expenditures on brakeshoes	£332	£196
Average power used over a period of 12 months, kw-hour per car mile	1.814	1.546

There was thus a saving of 41 per cent in the expenditure on brakes and a saving of 14.77 per cent in the average power used.

In addition, such items as the armature windings and field coils of the motors are not subject to such heavy current and high temperatures, with the consequent effect that their life is considerably prolonged, and the saving in maintenance cost of these items in the present case is approximately 33 per cent.

The wear and tear of permanent way with more gradual starting and stopping is also prolonged.

Some interesting efficiency calculations were made from the results obtained on the test hill. From the meter readings the average electrical power taken during the non-stop trial run was 54.83 hp. The theoretical power required to overcome rolling resistance, gradient and air resistance was calculated to average 44.81 hp at 9 m.p.h.* The over-all efficiency, therefore, is 81.72 per cent, the losses being accounted for in the motors and gears and slip of wheels. These losses are very moderate considering that the motors are of a type (GE-1000) designed about sixteen years ago. For these series-wound traction motors, at what is called half-speed, i. e., the motors on the cars being in full series at 250 volts, the efficiency would be about 75.3 per cent. In full parallel at 500 volts the efficiency would be about 81.5 per cent, including gear losses.

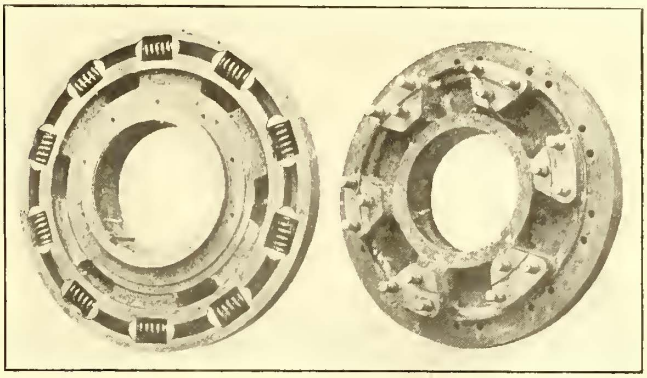
*In these calculations the rolling-resistance was taken at 30 lb. per ton, and the air-resistance allowed for was 0.0017 V^2 lb. per square foot, V being the speed in miles per hour.

HOOSAC TUNNEL SINGLE-PHASE LOCOMOTIVES

The Boston & Maine Railroad Company has had in service since the latter part of May five Westinghouse single-phase locomotives for freight and passenger service at the newly electrified Hoosac Tunnel, which was described in the Electric Railway Journal for July 1, 1911. One of these locomotives hauls each train and its steam locomotive with banked fire through the tunnel. This practically eliminates the obnoxious steam, smoke and gases incidental to steam operation. These locomotives have four geared motors, twelve wheels, and are designed for operation under an 11,000-volt trolley wire. Two are used for heavy freight service and the remaining three for combination passenger and light freight service.

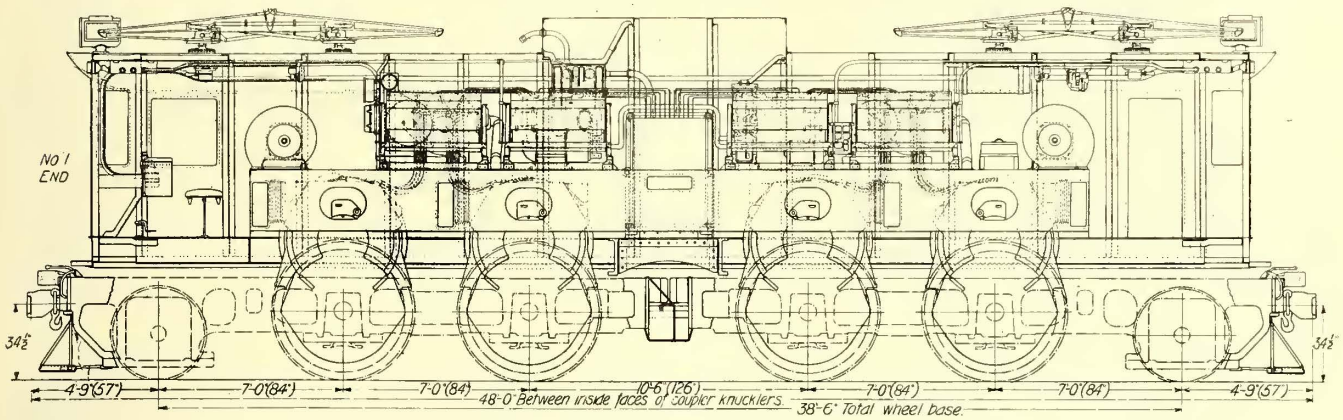
The electrified zone extends from Hoosac Tunnel Station, Mass., to North Adams, Mass., a distance of 7.92 miles, of which 4.75 miles are within the tunnel. The central zone of the tunnel has an almost level track 1200 ft. in length, with an ascending 0.5 per cent grade up to this level track from both the east and west portals. The passenger locomotives were designed to handle trains having a maximum weight of 730 tons, inclusive of steam and electric locomotives, and to maintain a schedule time of fourteen minutes between East Portal, Mass., and North Adams, Mass. The locomotives for freight service were built to handle heavy freight trains having a maximum weight of 2000 tons, including both steam and electric locomotives, and are required to accelerate this tonnage on the 0.5 per cent grade in the tunnel.

The under running gear consists of two massive trucks, known as 2-4-0 articulated trucks and fitted with 63-in. wheels. Each truck has two driving axles constituting a rigid wheel base of 7 ft. and a pilot axle arranged to swing radially. The truck side frames follow the general design of the cast-steel frames for steam locomotives, except that they are outside of the wheels. These frames are joined at each end by a cast-steel box section girder of sufficient strength to care for the stresses involved in bumping in freight service. The bumper girder at each end of the locomotive is equipped with an M. C. B. coupler mounted with a Westinghouse friction draft gear.

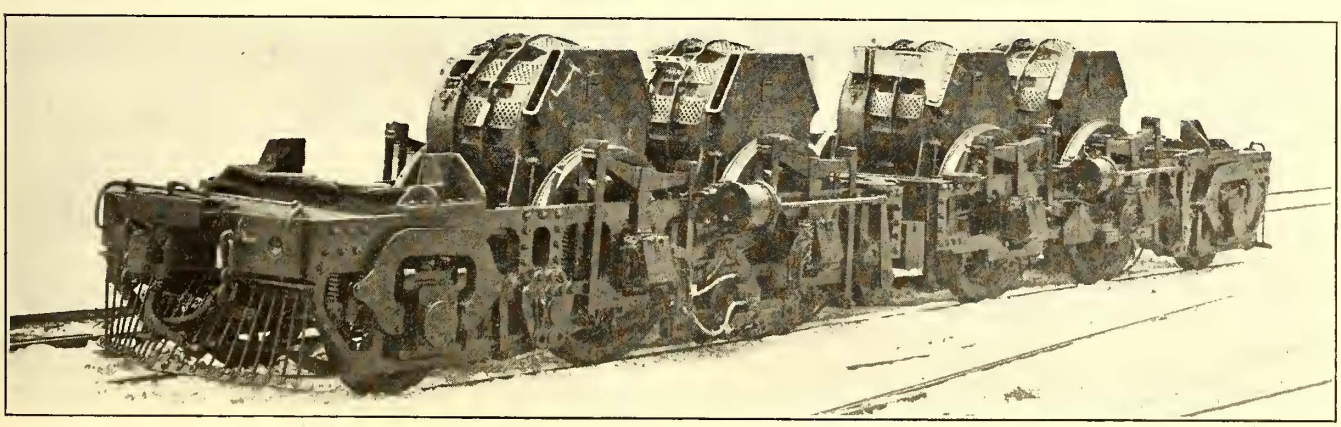


Hoosac Locomotive—Interior and Exterior of Gear Center

The adjacent bumper girders at the mid-length of the locomotive are joined by a drawbar with a pin connection at each end. The eye in this bar is elongated at one end and the length of the bar is so arranged that it is impossible for the bar to be subjected to compression under severe bumping conditions. The three wheels on each side of each truck are equalized together. The longitudinal stability of the trucks is provided by the method of mounting the cab. The cab is supported by eight spring-loaded friction plates, two plates resting on each end of each truck. This relieves the truck center pins of all the weight. This method of supporting the cab interposes two sets of springs in series between the rail and the cab and gives an exceptionally



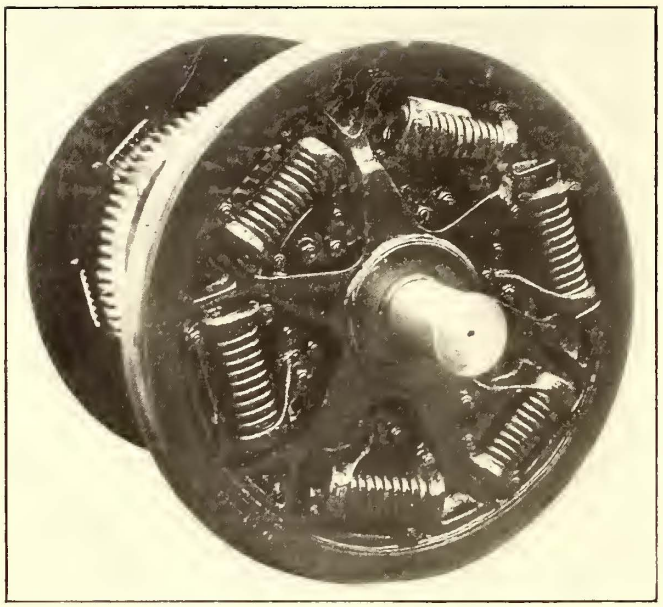
Hoosac Locomotive—Longitudinal Section and Principal Dimensions



Hoosac Locomotive—View of Trucks and Single-Phase Motors

easy riding cab. To relieve the cab from possible pulling and bumping strains the center pin of one truck is arranged with longitudinal clearance. This truck can not only rotate, but can also move longitudinally relative to the cab.

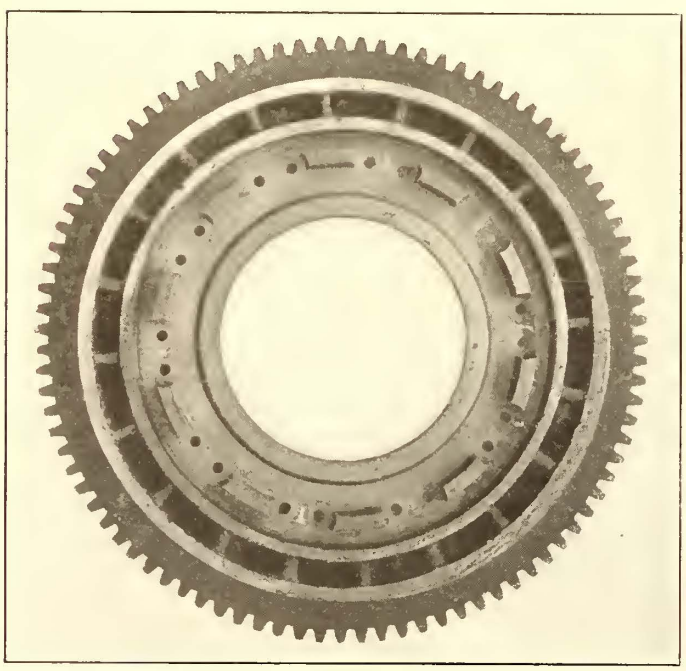
In the interior of the cab a long raised deck is built along the center line which covers the motors and serves as a stand upon which the control apparatus is erected.



Hoosac Locomotive—Pair of Driving Wheels

The central arrangement of the equipment, with the numerous side windows, affords excellent light and ample room for inspection and overhauling.

Each motor is bolted rigidly to cast-steel cross ties, and the weight of the motor is thus carried on the main semi-elliptic springs. The detail of this mounting is such that the motor can be lifted from the truck frame by a crane, after the cab has been removed, or the motor can be dropped into an overhauling pit when the trucks are in position under the cab. This method of mounting gives the highest center of gravity possible with a motor connected to the axle by single reduction gearing. It is particularly advantageous for locomotives that operate over tracks which are occasionally submerged.



Hoosac Locomotive—Gear Rim and Flange

Each end of the motor armature shaft has a solid pinion which meshes with a gear having a rim that is flexibly connected to the center. The gear centers are mounted on opposite ends of a hollow axle or quill which surrounds the wheel axle with a 1½-in. radial clearance between the inner and outer axles. The gear center is equipped with six arms arranged alternately with the wheel spokes. One end of each arm is bolted to one end of a helical spring and the other end is bolted to the wheel spoke. This spring is of sufficient flexibility to allow each wheel complete individual freedom in negotiating track inequalities.

The total weight of each locomotive is 260,000 lb., of which about 48,000 lb. is supported by each driving axle and about 34,000 lb. on each idle axle. The gear ratio for the three freight locomotives is 22:91 and for the two combination freight and passenger locomotives is 34:79. Each locomotive is equipped with four 315-hp air-cooled No. 403-A motors and with non-automatic unit switch control. The freight locomotives have a continuous tractive effort of 21,000 lb. at 21 m.p.h. and the passenger locomotives have a continuous tractive effort of 12,000 lb. at 37.5 m.p.h.

SEMI-STEEL CARS FOR HOUSTON, TEX.

The accompanying illustrations show one of the five semi-steel motor cars recently shipped to the Houston Electric Company by the St. Louis Car Company. The same builder has also furnished ten trailer cars which are of the same design except for the door arrangement in the vestibule. This type of car was designed by C. O. Birney for the Stone & Webster Management Association, which organization, the car builder states, has made it the standard city car for all of its properties. The principal features of this car are the semi-steel construction, which gives durability and light weight, the liberal inside dimensions, which help to make the cars airy and cool, and the flat-arch roof. Both types of cars have clam-shell detachable hoods and drop platforms.

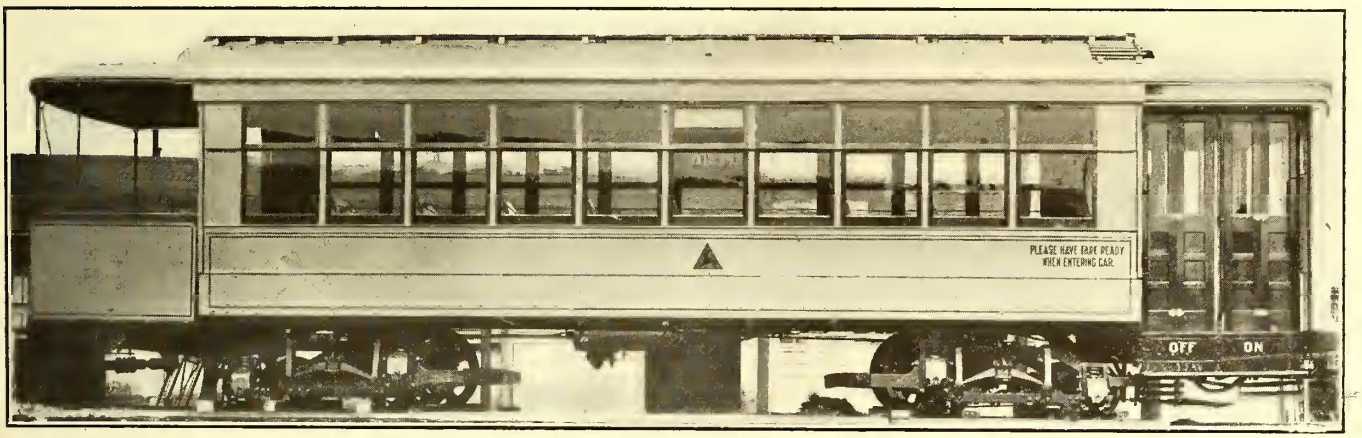
Interior of Houston Car

TRAIL CARS

The front bulkheads on the trailers are of the open type supported on 1-in. pipe stanchions. A cross pipe extends to the corner post on a line with the side window rests. The rear bulkhead has doors with a 40-in. opening

in the clear. The front platform is of the inclosed type with the opening and step on the right-hand side. This opening is 28 in. wide and is provided with a sliding door which the motorman operates through a lever without leaving his position. This sliding door is of solid mahogany with the lower part paneled up solid and the upper part fitted with stationary glass. The step is of the folding type and works in synchronism with the door. The front step is also arranged to work automatically with the back step stationary door. There are nine cross-seats and one longitudinal seat per side of car. The length of the cushions on the cross seats is 35 in.

The side sill angles extend around on the end sills in one continuous piece and are fastened together with riveted steel plates. The cross sills are reinforced with steel plate and angle iron and are bolted to the cross sill with carriage head bolts. The angles and plates are bolted to the side sill angle with countersunk head bolts, having nuts and lock washers. The tie rods have countersunk heads and turnbuckles in the center; these are placed at each cross sill. The side sill fillers are bolted to the side sill angles. The end sills are tenoned into the side fillers and are bolted to angle iron, reinforced at each end with angle iron, which is bolted to the side sill filler through the angle iron and end sill.



Flat-Arch, Semi-Steel Car for Houston, Tex.

The trap doors are of T-iron with angle iron braces in the center bolted securely to the cross timbers. The platform knee irons are bent to shape. The trolley boards extend the full length of the car and are screwed to the ribs. The base blocks are bolted to the trolley boards. The ribs are of oak, set in rubber and fastened to T-iron posts with stove bolts.

The window rests are copper flashed at the posts and fastened to the angle iron with bolts. The upper side and end panels are of No. 16 sheet steel lined with agasote on the inside. Both the lining and the sill are fastened to the post and seat rests with stove bolts and to window rests with screws. The roofing is of agasote molded to shape and fitted perfectly to the T-iron and letterboard before fastening. All top sashes are stationary in one continuous piece. The lower sashes rise 25 in. in the clear. All inside finish is solid mahogany. All wiring is placed in conduit.

MOTOR CARS

The motor cars are 41 ft. long and are of the same general construction as the trailers with the exceptions to be noted below:

The front platforms are of the inclosed type with the opening step on the right-hand side. At the right-hand opening there are two sets of folding doors equipped with horn locks and shields. These doors are operated by the conductor. The step is stationary. The back platform is of the open type. There are eight cross-seats and two longitudinal seats per car.

ALUNDUM-STEEL SAFETY TREAD

"Feralun" is a safety tread and general abrasive which has been perfected by the American Abrasive Metals Company, New York, after three years of service tests. This tread is a combination of iron or steel with alundum, one of the strongest and toughest abrasives known. Grains of alundum are embodied in and under the surface of the metal to obtain a uniformly gritty surface. Plates with this surface are made in any size, thickness or shape and in ribbed or hatched designs. The manufacturer recommends the square hatched surface with scoring extending diagonally from the nosing. The ribbed design is made only when it is specially called for, as the company believes that any surface with a rib parallel to the nosing on a step or stair tread is dangerous, particularly in catching high heels.

These treads have the anti-slip element in the very edge of the step, where people are most likely to place their feet when getting off a car or descending stairs. The sharp projecting alundum grains cut through snow and mud and will even penetrate a thin coating of ice to bite the soles of a passenger's shoes. It is also asserted that these treads have been found more durable than other designs.

An extremely light but durable form has been developed for electric car use. White oak steps are employed. A "Feralun" anti-slip nosing piece is placed in an offset extending along the entire edge 1½ in. wide. Back of this nosing piece "Feralun" buttons 1½ in. in diameter and ¼ in. thick are fastened with small brass screws into countersunk holes 2 in. on centers. This keeps the buttons close enough to prevent any appreciable wear on the wood, and as their surface is 1/32 in. above the wood at all times, an efficient anti-slip surface is presented. The buttons are not affected by moisture.

This tread is used in many other forms, as in ash and coal-conveying pipes and hoppers, crushing-machinery plates, grate bars, fire-door liners, floor plates in boiler rooms and for running boards around moving machinery where a slip would be dangerous.

Acting for the board of directors of the Lehigh Valley Transit Company, R. P. Stevens purchased from Mr. Hay, of Easton, and the Lehigh Valley National Bank of Bethlehem, the property of the Montgomery Traction Company, which runs from Norristown to Lansdale. It has a capital stock of $250,000 and is bonded for a like amount. This purchase gives to the Lehigh Valley Transit Company the last link for its proposed high-speed line from Sixty-ninth Street and Market Street, Philadelphia, to Delaware Water Gap, a distance of approximately 100 miles. The newly acquired property will be entirely rebuilt on a high-speed basis from Norristown to North Wales or Lansdale.

LONDON LETTER

The tenth annual conference of the Municipal Tramways Association was held recently in Glasgow. The delegates to the conference and their friends were received by the Lord Provost and the convener and members of the Glasgow tramways committee, in the city chambers. After J. Dalrymple, general manager of the Glasgow Corporation Tramways, presented his presidential address, a paper was read, "The Common Good of the City of Glasgow, Its Origin, History and Present Position in Relation to the Tramways Undertaking," by Councilor Walter Nelson, sub-convener of the Glasgow Corporation tramways committee. Luncheon was served in the city chambers. In the afternoon a paper was read on "Tramways Finances and Policy," by Councilor J. H. Rodgers, chairman of the Newcastle Corporation tramways committee. These papers were then discussed and the conference adjourned for the day. At the invitation of the Lord Provost and the convener and members of the Glasgow tramways committee a dinner was given in the evening in the city chambers at Glasgow to all the members of the conference. The conference was held at Newlands Depot on the second day. After meetings of the executive committee and the managers' section, a paper, "Tramcar Meters," was read by R. G. Cunliffe and J. G. Cunliffe, technical assistants of the Manchester Corporation Tramways. T. B. Goodyer, general manager of the Croydon Corporation Tramways, who has recently issued a long report on the subject of the use of tramcar meters on various systems, and W. Clough, general manager of the Bury Corporation Tramways, discussed this paper. A report, "Tramway Track: Methods of Construction and Maintenance," was read by the representatives of the Glasgow, Manchester and Leeds Corporation tramways, and a paper was submitted which gave answers to various questions which had been asked different corporations. After luncheon at Newlands Depot, the annual business meeting of the association was held, and in the afternoon a visit to one of Glasgow's beauty spots, Rouken Glen, was enjoyed by the members of the conference. The association dinner was held in the evening at Grosvenor Restaurant. As usual, the last day of the conference was devoted entirely to pleasure, an excursion having been arranged to the land of Burns. En route those in attendance were entertained at luncheon at the town hall, the luncheon being a courtesy extended by the tramways committee of Ayr.

One of the papers presented at the meeting of the Municipal Association described the Adkins-Lewis system of continuous transport, which employs a threaded shaft extending throughout the whole route and rotating at constant speed. It is intended with this system to drive a number of small cars by the shaft, the cars at stations not coming entirely to rest due to the varying pitch of the spiral. At stations the cars would travel at only 3 m.p.h., thus enabling passengers to step off and on with ease. Between stations the pitch of the spiral would increase to five or six times the pitch at the stations. The shaft would be driven by electric motors placed at intervals of about a quarter of a mile. The system has been reported upon by H. M. Hobart, of the General Electric Company of America. It is understood that the Central London Railway is considering a plan to adopt this system to connect one of its stations and the station of another tube which is a few hundred yards away.

The London County Council has been singularly immune from tramcar accidents, but a serious accident occurred recently at New Cross, when a four-wheel car was overturned at a corner, with the result that one person was killed and twenty or thirty were injured. The Board of Trade inquiry elicited the information that the magnetic brake and the car generally were in good order, and that the rails seemed to be in good condition. At present the engineering staff of the London County Council is conducting an investigation to ascertain the cause of the accident. London's most serious tramway accident occurred on Highgate Hill, in 1906, but the tramway was not at that time owned by the London County Council.

With the sanction of the Board of Trade, the London County Council is experimenting on the Euston Road and Hampstead route with a train of two cars to ascertain the possibilities of running trail cars in London. Each of the cars used in the experiment is a motor car equipped with brakes, but connected for unit operation. If the method is found to be safe the sanction of the Board of Trade is expected for the use of trail cars when traffic is most heavy.

The trackless trolley system at Bradford has proved so successful that the tramways committee has decided to extend the system 11 miles and purchase twelve new cars. The route chosen for the trial extended for 1¼ miles, and connected existing sections of the tramway system. It cost £6,000 to install the trackless trolley and supply cars. The overhead equipment erected for this experiment could be used should it ever be thought desirable to lay rails. The cost of operating the trackless system has not yet been worked out, but an estimate which includes current wages places the cost at 6½d. per car mile. After allowing for sinking fund and interest the cost amounts to about 7½d. per car mile. One of the most important corporations studying the system at present is that of Oldham, and the matter is now before the tramways committee. There are two companies in England at present which are prepared to install trackless trolleys, the R. E. T. Construction Company, London, which installed the Bradford and Leeds systems, and Trackless Trolley, Ltd., London, which is prepared to install the Mercedes-Stoll system, which is already in successful operation on the Continent.

The tramways committee of the Cardiff Corporation has been experimenting with a transfer ticket system which has proved very successful. More than 2,500,000 of these tickets have been sold during the year, and they have helped to increase the revenue of the tramway department. The committee has also established a tramways parcels express service, which is likewise proving a success. Anyone who desires to send a parcel has to buy a "parcel stamp," which is sold at the rate of 2d. for 7 lb., 3d. for 14 lb., and 4d. for 28 lb., by a district agent. The parcel, with the stamp affixed, is handed to the conductor of a car, who delivers it to the central offices, from which it is delivered by special messenger. Deliveries are not made outside the city boundary or more than half a mile from the tram line. Letters, live stock and parcels of an objectionable nature are not carried. Insurance can also be effected at a very small rate on parcels up to the value of £25. Parcels of greater value than £25 are, however, refused.

D. N. Dunlop, for many years manager of the publishing department of the British Westinghouse Company, and manager of the sales department, has been appointed secretary to the British Electrical Manufacturers and Allied Trades Association. A few years ago the National Electrical Manufacturers' Association was formed, but this association is to be reorganized and is to have a permanent official in Mr. Dunlop, with an adequate staff. Many of the important manufacturing companies which held aloof from the other association have come into the reorganized association.

The Glasgow Corporation is considering the construction of several extensions outside the city. The most important of the extensions are to Milngavie, Coatbridge and Clarkston. At a recent meeting of the tramways committee Mr. Dalrymple stated that the tramways committee and the corporation have hitherto acted on the principle that a complete tramway system cannot be circumscribed by artificial boundaries. He pointed out that the proposals now made would, if carried out, almost complete the original scheme of a comprehensive tramway system laid out by the tramways committee years ago. In defence of these outside routes, he also stated that the cost of operating a car outside the city was considerably less than in the central area. It is only necessary, therefore, to carry a few passengers to meet the operating expenses. He reiterated that a Glasgow tramway system confined entirely to the city was unthinkable. In conclusion he stated that if the tramways committee and the corporation had decided to confine the system within the city boundaries the surrounding communities would long ago have secured tramways into the city by private enterprise.

A. C. S.

News of Electric Railways

Chicago Subway Commission Ordinance Modified

The committee on local transportation of the City Council of Chicago has modified the proposed ordinance to create a temporary subway commission, and has ordered the ordinance deferred and published. The ordinance as revised by the committee follows:

"Section 1. There is hereby created a special commission to be known as the Subway Commission of the City of Chicago, which shall consist of three members to be appointed by the Mayor by and with the approval and confirmation of the City Council. The members of said commission shall be competent and experienced engineers. The city engineer of Chicago may be appointed as one of the members of said commission.

"Section 2. Said commissioners shall prepare and submit to the City Council plans and specifications for the construction of a system or systems of underground subways and tunnels in and under the streets, alleys and public grounds of the city, the Chicago River and its branches and the drainage canal, to be owned by Chicago for the operation therein of street railways, including elevated railroads.

"Section 3 provides for maintenance of an officer and employment of help.

"Section 4 provides a salary of $12,000 a year for each commissioner, except the city engineer, providing he be a commissioner, who would be paid $8,000."

Validity of Ordinance Granting Franchise Sustained

On September 26, 1911, the Supreme Court of the State of Oklahoma, handed down a decision, upholding the franchise of the Oklahoma Railway, Oklahoma City, Okla., which gives this company an indeterminate blanket franchise over all streets and alleys in Oklahoma City.

This company was granted a franchise in 1905 on certain streets of Oklahoma City. In 1909 the City Council adopted an ordinance extending this franchise over the entire city, which was ratified by a vote of the qualified electors of the city at an election called under the new initiative and referendum law of Oklahoma. The company began construction in one of the principal streets of the city. The validity of the franchise was questioned in the name of abutting property owners. Claims were made to the court that there was no authority of law warranting the enlargement of a franchise, and that, as the constitution of Oklahoma provided that no franchise should be granted, extended or renewed for a longer term than twenty-five years, and that as the franchise in question was practically a perpetual franchise, an ordinance amending this franchise extending it over all of the streets of the city was void. The decision of the Supreme Court completely sustains the validity of the ordinance of 1909 giving the Oklahoma Railway an indeterminate, blanket franchise over all of the streets of Oklahoma City.

New Rapid Transit Routes Adopted in New York

The Public Service Commission of the First District of New York has adopted new rapid transit routes for the benefit of Queens. The resolution passed by the commission must first have the assent of the Board of Estimate before bids can be asked for their construction. These new routes are part of the tentative plans which were adopted some time ago by the commission for laying out a comprehensive interborough system. These routes are in accordance with the program laid down in the report of June 5, 1911, of the committee of the Board of Estimate and of the Public Service Commission. In that report it was estimated that the line from Fifty-ninth Street to Queens Plaza would cost about $2,500,000, with 1.7 miles of subway track and 2.9 miles of elevated track; that the Astoria line would cost $1,700,000, with 4.8 miles of elevated track, and the Corona and Woodside line $2,800,000, with 7.4 miles of elevated track. Accordingly if these routes are legalized by at least one-half in value of the property owners it would be possible for the estimated sum of $7,000,000 to offer rapid transit facilities through Fifty-ninth Street over the Queensboro Bridge to Astoria and Woodside.

The Public Service Commission of the First District of New York has authorized the carrying out of the contract made by the Long Island Railroad with F. H. Clement & Company, of Philadelphia, for the removal of the grade crossings of the north side division of the Long Island Railroad Company in Flushing.

Decision Regarding Fares on Interurban Cars in Cleveland

Judge Vickery of the Common Pleas Court at Cleveland has ruled that interurban cars which enter Cleveland, Ohio, will have to be operated at a fare of 3 cents, with free transfers, and that such cars must stop at all crossings where city cars stop. The decision was made in overruling the demurrer filed by Kline, Tolles & Morley to the petition of A. G. Safford, who commenced litigation about two months ago. The court held that the interurban railways bring their cars into the city through an agreement with the Cleveland railway and that the interurban companies are subject to the provisions of the Tayler franchise. Unless this decision is reversed by a higher court the interurban railways will be compelled to abandon the 5-cent fare they have been receiving. The case will be carried to the Supreme Court. Judge Vickery said that he believes that the law should be amended to prevent city traffic interfering with the through traffic of the interurban railways.

Ford, Bacon & Davis to Report on Maryland Electric Railways.—Ford, Bacon & Davis, New York, N. Y., have been engaged to make a complete report on the Maryland Electric Railways Company.

Hudson & Manhattan Railroad Assessment Reduced.—The Court of Appeals has decided that the Hudson & Manhattan Railroad is entitled to a reduction of 11 per cent from the State tax board's assessment against the company's special franchise in the borough of Manhattan for 1908 and 1909.

Plan to Connect Albany, N. Y., and Pittsfield, Mass.—R. A. C. Smith, president of the Albany Southern Railroad, Hudson, N. Y.; J. H. Pardee, vice-president of the company; William Loeb, Jr., and C. L. Rossiter, directors of the company, were members of a party which visited Pittsfield, Mass., recently in the interest of the plan to extend the Berkshire Street Railway from West Pittsfield, Mass., over Lebanon Mountain to the New York State line to connect with the Albany Southern Railroad. This would complete connections between Pittsfield and Albany.

British Columbia Water-Powers.—In connection with the probable ultimate electrification of a portion of its line in the mountains, the Canadian Pacific Railway has acquired a water-power on the Adams River, which flows into South Thompson River near the west end of Shuswap Lake. The Adams River flows out of Adams Lake and is capable of developing 100,000 hp at two different points between the lake and its confluence with the South Thompson. It is in a heavily timbered country, where extensive lumbering operations are now being carried on. During a recent visit to the Okanagan Valley Sir William MacKenzie, president of the Canadian Northern Railway, bought the Coteau water-power and a charter for building an electric railway through the fruit-growing belt on both sides of Okanagan Lake.

Pacific Electric Railway Organization.—The personnel of the various divisions of the Pacific Electric Railway, Los Angeles, Cal., was published in the Electric Railway Journal of Sept. 30, 1911, page 546. What was formerly known as the San Bernardino Valley Traction Company is now called the San Bernardino division; what was formerly known as the Riverside & Arlington Railway is now called the Riverside division. The Pomona city lines,

which were formerly included in the northern division of the Pacific Electric Railway, are included in the Riverside division. This arrangement makes of the entire system the following five divisions: Southern division, Northern division, Western division, San Bernardino division and Riverside division.

The Barbadoes Tramways.—H. E. Chubbuck, vice-president executive of the Illinois Traction System, is quoted as follows in regard to the plans of the Bridgetown Tramway, in which William B. McKinley, president of the Illinois Traction System, and his associates are interested: "W. R. Morrison, who was general superintendent of the Wichita Light & Railroad Company, Wichita, Kan., will likely have to leave Wichita some time in October. The Barbadoes Legislature meets in November and it is expected that Mr. Morrison will be there at that time. As soon as a slight change is made by the Legislature in the charter which the company holds the work of rebuilding the system in Bridgetown will be begun. It is probable that E. W. Woodman, Portland, Maine, will accompany Mr. Morrison. Mr. Woodman is onc of the largest stockholders in the company." The selection of Mr. Morrison as the representative of the McKinley interests in Barbadoes was announced in the Electric Railway Journal of Aug. 12, 1911.

Negotiations in Toledo.—At a meeting of the directors of the Toledo Railways & Light Company on Sept. 28, 1911, the action of the City Council in adopting a resolution to open negotiations on the question of fare was approved and Albion E. Lang, president of the company, was named as a committee to represent the company. The resolution of the city was adopted on Sept. 7, 1911, and provided that a committee of the City Council co-operate with a committee appointed by the company to investigate the books with a view to ascertaining what rate of fare will yield a proper return on the investment. Mayor Brand Whitlock, Councilmen Merrill, Robson and Spitzer and City Solicitor Cornell Schreiber compose the committee named to represent the city. It is understood that at the meeting in New York which Mr. Lang attended recently the committee of bondholders considered the extension of $5,330,000 underlying bonds, due Jan. 1, 1912, and $700,000 underlying bonds, due Feb. 1, 1912. Some time ago the City Council passed an ordinance assessing a rental of $250 a day on the company for the use of the streets on which franchises are claimed to have expired. The company refused to pay the accumulated rentals, amounting to $70,000. This matter is in the courts, but may not be brought up pending negotiations.

Denver City Tramway Protests Tax Assessment.—Attorney Gerald Hughes, representing the Denver (Col.) City Tramway, appeared before the county commissioners recently to protest against the assessment of $4,782,753 placed against that company by the county assessor. Mr. Hughes said that the assessor would have the company pay one-twentieth of all the taxes levied in Denver. The company did not think that it should bear that proportion of the burden. It has been assessed on a real valuation of $14,000,000, of which $10,000,000 is for franchise. The actual value of a franchise is hard to determine, but Mr. Hughes did not think that the company's franchises were worth any such sum. It had two main franchises, that of 1865, which is in litigation, and therefore of doubtful value, and that of 1906, which has only fifteen years to run. Mr. Hughes contended that a franchise decreases in value as its time limit draws near, whereas the tax commission would increase the assessed value. He thought that a fair way of arriving at a just assessment would be to use the earnings of the company as a basis. The gross earnings for the year ending April 1, 1911, were $3,200,000. The operating expenses were $1,600,000. The taxes and franchise rent was $200,000, and the depreciation on $6,000,000 worth of property at 5 per cent was $300,000, leaving a net income of $1,100,000, which, capitalized at 10 per cent, gives a value of $11,000,000. Mr. Hughes thought that one-third of this amount would seem to be the true assessed value. Subsequently at a meeting of the county commissioners Mr. Hughes asked that a reduction of $1,250,000 be made in the assessment, and the commissioners, after reviewing the data furnished by him, made a reduction of $699,969.

Financial and Corporate

Oct. 12, 1911.

In spite of the dullness of the past week, public interest in the markets is awakening as a result of the low prices now prevailing, and the prospects are imparting a more cheerful tone to the Street. While trading has exhibited no marked feature, other than irregularity in volume and prices, the market is gaining strength from the improvement on foreign exchanges, and prices were much firmer to-day than earlier in the week. Heavy withdrawals by Southern interests for financing the crops have been a feature of the local money market this week. Quotations to-day were: Call, 2¼@2½ per cent; ninety days, 3½@3¾ per cent.

Other Markets.

There was very little business transacted to-day on any of the exchanges, due to approach of the holiday.

Prices on the Chicago list were higher to-day, with few exceptions.

Trading in Philadelphia was very narrow, and price changes were unimportant.

This was also the case in Boston, sales being in small lots, with trifling changes over yesterday's quotations.

The tone of the Baltimore market to-day was greatly improved, and prices showed an upward tendency. Gains were made in Consolidated Power and United Railways & Electric Company.

Quotations of traction and manufacturing securities as compared with last week follow:

	Sept. 30.	Oct. 11.
American Light & Traction Company (common)	a295	a303
American Light & Traction Company (preferred)	a107	a108
American Railways Company	a44	a44
Aurora, Elgin & Chicago Railroad (common)	a43	*43
Aurora, Elgin & Chicago Railroad (preferred)	a87	*87
Boston Elevated Railway	a125	a126
Boston Suburban Electric Companies (common)	a14	a15
Boston Suburban Electric Companies (preferred)	a75	a75
Boston & Worcester Electric Companies (common)	a10½	a12
Boston & Worcester Electric Companies (preferred)	a51	a51
Brooklyn Rapid Transit Company	a74⅛	74½
Brooklyn Rapid Transit Company, 1st ref. conv. 4s	*83	84⅛
Capital Traction Company, Washington	a128	130½
Chicago City Railway	a180	a185
Chicago & Oak Park Elevated Railroad (common)	3	3
Chicago & Oak Park Elevated Railroad (preferred)	6	6
Chicago Railways, ptcptg., ctf. 1	a95	a95
Chicago Railways, ptcptg., ctf. 2	a27¼	a28½
Chicago Railways, ptcptg., ctf. 3	a10	a10
Chicago Railways, ptcptg., ctf. 4	a6⅜	6⅜
Cincinnati Street Railway	a131½	a131
Cleveland Railway	a100	100
Columbus Railway (common)	83	83
Consolidated Traction of New Jersey	a75½	a75
Consolidated Traction of N. J., 5 per cent bonds	a104	a104
Dayton Street Railway (common)	a25	a25
Dayton Street Railway (preferred)	a101	a101
Detroit United Railway	a70	a73⅛
General Electric Company	149½	150
Georgia Railway & Electric Company (common)	a162	a162
Georgia Railway & Electric Company (preferred)	a93	a93
Interborough Metropolitan Company (common)	21⅛	14⅞
Interborough Metropolitan Company (preferred)	57	45
Interborough Metropolitan Company (4½s)	77½	79
Kansas City Railway & Light Company (common)	a19	a17
Kansas City Railway & Light Company (preferred)	a45	45
Manhattan Railway	135½	a136
Massachusetts Electric Companies (common)	a19	a19⅞
Massachusetts Electric Companies (preferred)	a89	a93
Metropolitan West Side, Chicago (common)	*27	*27
Metropolitan West Side, Chicago (preferred)	*75	*75
Metropolitan Street Railway, New York	a8	*8
Milwaukee Electric Railway & Light (preferred)	110	*110
North American Company	65	67½
Northern Ohio Light & Traction Company	a57	a55
Northwestern Elevated Railroad (common)	*30	30
Northwestern Elevated Railroad (preferred)	*70	70
Philadelphia Company, Pittsburgh (common)	a50	50
Philadelphia Company, Pittsburgh (preferred)	a42¼	42¼
Philadelphia Rapid Transit Company	a20⅞	21½
Philadelphia Traction Company	a83	a83
Public Service Corporation, 5% col. notes (1913)	94	*94
Public Service Corporation, ctfs.	a103½	103½
Seattle Electric Company (common)	a110	a110
Seattle Electric Company (preferred)	100	100
South Side Elevated Railroad (Chicago)	a95½	95½
Third Avenue Railroad, New York	8	9¼
Toledo Railway & Light Company	6½	6½
Twin City Rapid Transit, Minneapolis (common)	a106½	*106½
Union Traction Company, Philadelphia	a49¼	49½
United Ry. & Electric Company (Baltimore)	18	*18
United Rys. Inv. Co. (common)	31	30½
United Rys. Inv. Co. (preferred)	56	55½
Washington Ry. & Electric Company (common)	a40	a40
Washington Ry. & Electric Company (preferred)	a89	a89
West End Street Railway, Boston (common)	a85½	86⅝
West End Street Railway, Boston (preferred)	a100¼	a101
Westinghouse Elec. & Mfg. Co.	62	61⅝
Westinghouse Elec. & Mfg. Co. (1st pref.)	a111½	a115

a Asked. *Last sale.

ANNUAL REPORT

New York, New Haven & Hartford Railroad

In the report for the fiscal year ended June 30, 1911, Charles S. Mellen, president of the New York, New Haven & Hartford Railroad, mentions many matters connected with the electrification policy of the company or controlled electric railway properties. The portions of the report in which these references are made are, in part, as follows:

"Deferring to the wishes of many investors, a combined income account and general balance sheet of all companies comprised in the New Haven system have been prepared, excluding only the New York, Ontario & Western, Boston & Maine and controlled lines and Maine Central and controlled lines, your interest in which has been treated as investments.

"From this account it will be seen that had all of the surplus earnings of all of the companies for the fiscal year been turned into the treasury of your company they would have failed by only $313,288 of meeting the New Haven dividend for the year.

"The surplus earnings in the treasuries of subsidiary companies available for dividends were more than sufficient, if paid into the treasury of the parent company, to have met the deficiency of its earnings to pay its dividends, but your directors did not deem it advisable to deplete the treasuries of the subsidiary companies for that purpose.

"The expenses of the combined companies include some of an extraordinary nature, which, it is believed, may be avoided in the future. Among these may be mentioned the cost of the appraisal of the companies' properties in connection with the validation of the companies' securities claimed to have been issued in violation of the laws of the Commonwealth of Massachusetts; the trolley properties were found to have a large amount of equipment that had been carried upon their books for many years that was obsolete for their purposes, but was still in shape to be used in emergencies, the value of which has been written off to the expenses for the year; the steamboat companies have sold and broken up boats that stood upon their books at very considerable valuations, which have been also written off in the year's expenses, so that the property of the companies stands upon their books at a much more conservative valuation than heretofore.

"The interest during construction on the investment in the New York, Westchester & Boston Railway, the New York Connecting Railway, the Berkshire Street Railway, the electrification work upon the Harlem River branch, and the double tracking of the Poughkeepsie Bridge line, none of which has reached a stage to make returns in earnings, has been included in the interest charges of the companies (and not offset in any way by the securities eventually to be received, which will be available for sale), and the results from these investments and economies from these improvements, nearly all of which will be available during the next fiscal year, will be reflected in the statements for that and future years' operations.

"It will be noted that many of the items that have made up the charges to the expense accounts for the past year could have properly been charged to the profit and loss and investment accounts, and have thereby resulted in a surplus for the year instead of the deficit shown, but the net result to the property would have been unchanged.

"As yet your company has received no return from its investment in the New York, Westchester & Boston Railway, although its income has been charged with the interest upon the money required to be raised for the purpose.

"Part of this investment is represented by $16,300,000 of bonds, no part of the interest on which, amounting on June 30, 1911, to $1,238,926, has been credited to income.

"While notes have been given for this interest and for interest on advances amounting to a further sum of $58,465, or a total of $1,297,391, which will eventually be paid, your directors feel that it is in consonance with conservative accounting to defer the consideration of the crediting of this interest to the earnings of the company until the money has actually reached the treasury.

"Had this interest been available as a credit to earnings during the fiscal year of 1911, the deficit of the New York, New Haven & Hartford Railroad proper would have been converted into a surplus of $29,851 and the deficit of all companies into a surplus of $984,103.

"The New York, Westchester & Boston Railway extends from the Harlem River about Willis Avenue, New York City, through the borough of the Bronx and Westchester County to Mount Vernon, where the line diverges, one line extending north through Eastchester, New Rochelle, Scarsdale and White Plains, and the other line extending to the east through North Pelham, New Rochelle, Larchmont, Mamaroneck and Rye to the Connecticut State line at Port Chester.

"The physical property of the New York, Westchester & Boston Railway is of the best of construction known to engineering science. The road is four-tracked from 174th Street to Mount Vernon, where two tracks diverge to White Plains and two to New Rochelle. The entire line will be fenced in private right-of-way and protected with block signals. There will be no grade crossings.

"The company has obtained from the city of New York and the Public Service Commission the necessary rights to construct at 180th Street and Morris Park Avenue, borough of the Bronx, a transfer station at which interchange will be made with the West Farms branch of the Interborough Rapid Transit Company. Interchange will also be made with the Second and Third Avenue elevated lines at Willis Avenue. The plans of the company also provide for interchange with the proposed tri-borough route, either at the transfer station at 180th Street or at Westchester Avenue. The third tracking of the Second and Third Avenue elevated systems will give fast express service to and from all points in the Borough of Manhattan. The connection via the transfer station and via the Second and Third Avenue elevated lines at Willis Avenue offers rapid transit in connection with those lines to and from the west side, center and east side of Manhattan.

"The territory served forms one of the most desirable and rapidly growing residential sections in and adjacent to New York City. Between 1900 and 1910 the population of the borough of the Bronx increased from 200,507 to 430,980, or 115 per cent, and the population of Westchester County from 184,257 to 283,000, or over 53 per cent.

"By authority of the Public Service Commission of New York, Second District, the New York, Westchester & Boston Railway has canceled its old mortgages and created a new mortgage dated July 1, 1911, maturing July 1, 1946, under which the total amount of bonds which can be outstanding at any time shall not exceed $60,000,000, but no bonds can be issued in excess of the $17,200,000 at present issued, except against additional construction, betterments or improvements to the property of the railroad.

"This entire issue of $17,200,000 was delivered to the New Haven company in exchange for the old bonds held by it; your company has indorsed its guaranty of principal and interest on the bonds and has sold them at a satisfactory price.

"The most important pieces of work that have been under prosecution by the electrical department during the past fiscal year are: (1) The electrification for freight and passenger operation of the six-track Harlem River road, inclusive of yards and sidings on this line and between Woodlawn and Stamford. (2) The electrification of the New York, Westchester & Boston Railway. (3) The rehabilitation of Warren power station, with attendant increase in the capacity of the East Providence substation.

"Electrification of the Harlem River six-track road.—Beginning April 1, ground was broken for the installation of catenary piers, and the work is now well under way. Four types of electric road engines are in operation, handling either passenger or freight trains. We have received an electric switch engine based upon specifications that covered our heaviest switching practice in the Harlem River branch yards, and it is at present doing duty in the Stamford yards. Fifteen electric switching engines of practically similar type, modified only slightly in mechanical and electrical characteristics from experience received with the present engines, are on order.

"Orders for four all-steel motor cars and twelve trail cars for multiple unit service have been placed. The extension of Cos Cob station for the purpose of supplying power to the Harlem River branch and New York, Westchester and Boston Railway and for substation

plants with motor-driven street railway generating apparatus in the vicinity of our electric zone, has been authorized, it being the intention to install four 4000-kw, 80 per cent power factor, single-phase, 11,000-volt, 25-cycle turbo-generators, with necessary auxiliary steam equipment for operation.

"Your directors have deemed it advisable to join the Pennsylvania Railroad in the construction of the New York Connecting Railroad, in which your company has been a half owner from the inception of the project.

"This road is designed to be the new route for the interchange of traffic between the Pennsylvania and New Haven systems in lieu of the present passenger and freight ferry service between the Pennsylvania system on the west bank of the Hudson River and the New Haven system at Harlem River and Oak Point.

"For the present water haul freight service from the west bank of the Hudson River via the East River to your company's terminals at Harlem River and vicinity, a distance of about 14 miles, it substitutes a short water haul of about 4 miles from Greenville, N. J., to Bay Ridge, borough of Brooklyn, a rail haul of 11½ miles from Bay Ridge to Fresh Pond Junction to Port Morris via the New York Connecting Railroad, or a total distance of approximately 23 miles.

"Provision is also to be made for access to the New York passenger station of the Pennsylvania Railroad at Thirty-second Street and Seventh Avenue by means of a connection from Bowery Bay Road on the New York Connecting Railroad to the Long Island tunnel terminal at Sunnyside yard, a total distance from Port Morris to the New York station of about 9¼ miles.

"The present float service is subject to delays and dangers due to fog, tides and the crowded condition of the Hudson and East Rivers, which will be almost entirely eliminated by the new route; besides, the populous territory of the Long Island Railroad will be opened up to the New Haven lines and access afforded to the Pennsylvania's New York passenger station and by that means to the benefits to be derived from a largely increased interchange of passenger traffic between the two systems.

"The New York Connecting Railroad will be operated by the New Haven company and the results shared by the Pennsylvania and New Haven systems proportionately to their respective earnings on the freight traffic interchanged.

"Your company's present investment in the New York Connecting Railroad amounts to about $2,500,000 represented by the cost of one-half of the capital stock and by advances of one-half of the total expenditures for real estate, right-of-way and engineering. The investment in capital stock, approximately $1,500,000, has been carried without any income return.

"The construction of the railroad, including bridges, will cost approximately $20,000,000, the funds for which will be provided by an issue of bonds guaranteed jointly by the Pennsylvania Railroad and the New York, New Haven & Hartford Railroad."

A statement is presented in the report showing the combined income of all the properties except that intercompany transactions are eliminated. This gives the following facts regarding the controlled electric railway properties:

The Connecticut Company operates 782.994 miles of street railway lines, of which 479,969 miles are owned and 303,025 leased.

The New York & Stamford Railway operates 33.97 miles of street railway lines, of which 20.16 miles are owned and 13.81 leased.

The Westchester Street Railway operates 28.60 miles of street railway lines, of which 22.63 miles are owned and 5.97 leased.

The Berkshire Street Railway operates 111.881 miles of street railway lines, all of which are owned.

The Vermont Company operates 20.849 miles of street railway lines, all of which are owned.

Hoosick Falls Railroad operates 7.105 miles of street railway lines, all of which are owned.

The Rhode Island Company operates 347.02 miles of street railway lines, of which 38.67 miles are owned and 308.35 leased.

Included in the new equipment purchased during the year were two freight and one switch electric locomotives.

Bartlesville (Okla.) Interurban Railway.—William H. Byers & Company, New York, N. Y., offer at par and interest $150,000 of first mortgage 6 per cent gold bonds of the Bartlesville Interurban Railway dated Jan. 1, 1910, and due July 1, 1934, but redeemable at 102 at any interest period on six months' notice.

Boston (Mass.) Elevated Railway.—The Boston Elevated Railway has petitioned the Railroad Commission for approval of an issue of $5,000,000 negotiable bonds, proceeds to be used for construction and equipment, funding floating debt, and for the purchase of such real or personal estate as may be necessary for operation. This issue was authorized by the stockholders on Sept. 29, 1911.

Lake Superior Corporation, Sault Ste. Marie, Mich.—T. J. Drummond, president of the Lake Superior Corporation, refers as follows to the Trans-St. Mary's Traction Company in the report of the Lake Superior Corporation for the year ended June 30, 1911: "The International Transit Company commenced the year with a debit balance. This has been entirely wiped out and a small profit carried forward. The Trans-St. Mary's Traction Company, with extra service now given, is expected to show increased earnings. The ferry connecting these roads shows satisfactory results."

Oakland (Cal.) Railways.—The unsold portion of the total authorized issue of $2,500,000 collateral trust 6 per cent 4-year gold notes of the Oakland Railways is being offered for subscription at 100½ and interest by E. H. Rollins & Sons, New York and Boston. The notes are guaranteed by indorsement by the Oakland Traction Company, the San Francisco, Oakland & San José Consolidated Railway and the East Shore & Suburban Railway. These notes are dated Sept. 1, 1911, and are due Sept. 1, 1915, but are redeemable on any interest date on sixty days' notice at 102 and interest.

Sedalia Light & Traction Company, Sedalia, Mo.—Undeposited bonds of the Sedalia Light & Traction Company will be received by the bondholders' committee at the New York Trust Company until Oct. 16, after which date they will only be received on such terms as the committee may direct. The committee now represents more than $500,000 par value of the total issue of $749,000. Sale under the decree of foreclosure is expected in the near future and the property will probably be bid in by the bondholders' committee. In that case bondholders who do not deposit their bonds with the committee will receive only their pro rata share of the amount bid by the committee, less expenses and receivers' obligations.

MONTHLY ELECTRIC RAILWAY EARNINGS

CHATTANOOGA RAILWAY & LIGHT COMPANY.

Period.			Gross Revenue.	Operating Expenses.	Net Revenue.	Fixed Charges.	Net Income.
1m.,	Aug.	'11	$83,990	$50,411	$33,579	$20,333	$13,246
1 "	"	'10	77,085	43,485	33,600	18,554	15,046
8 "	"	'11	614,120	357,796	256,324	157,799	98,525
8 "	"	'10	573,925	336,656	237,569	145,986	91,583

COMMONWEALTH POWER, RAILWAY & LIGHT COMPANY.

1m.,	Aug.	'11	$440,895	$270,234	$170,661	$105,532	$65,129
1 "	"	'10	423,199	241,075	182,124	101,538	80,586
8 "	"	'11	3,507,171	2,035,826	1,471,345	831,263	640,082
8 "	"	'10	3,267,000	1,849,045	1,417,955	820,126	597,829

DETROIT UNITED RAILWAY.

1m.,	Aug.	'11	$1,001,531	$649,417	$352,114	$176,839	$175,275
1 "	"	'10	914,329	587,863	326,466	178,464	148,002
8 "	"	'11	6,829,108	4,291,990	2,537,118	1,411,494	1,125,625
8 "	"	'10	6,283,744	3,945,374	2,338,370	1,332,318	1,006,052

EAST ST. LOUIS & SUBURBAN COMPANY.

1m.,	Aug.	'11	$193,413	$111,866	$81,547	$45,739	$35,808
1 "	"	'10	215,316	117,288	98,028	46,531	51,497
8 "	"	'11	1,480,821	845,510	635,311	365,939	269,372
8 "	"	'10	1,545,513	861,612	683,901	365,939	318,451

TWIN CITY RAPID TRANSIT.

1m.,	Aug.	'11	$671,325	$317,043	$354,282	$140,079	$214,203
1 "	"	'10	660,657	298,323	362,333	140,113	222,221
10 "	"	'11	5,163,343	2,583,392	2,583,392	1,120,633	1,459,318
10 "	"	'10	4,925,516	2,365,045	2,365,045	1,121,367	1,439,104

UNION RAILWAY GAS & ELECTRIC COMPANY.

1m.,	Aug.	'11	$254,812	$142,477	$112,335	$62,402	$49,933
1 "	"	'10	232,494	132,795	99,699	57,927	41,772
8 "	"	'11	2,018,199	1,182,179	836,020	488,475	347,545
8 "	"	'10	1,895,832	1,129,077	766,755	465,429	301,326

Traffic and Transportation

Accidents in Indiana During Three Months

The Railroad Commissioner of Indiana has issued Bulletin No. 16, which contains a summary of the accidents on the steam railroads and the electric railways operated in Indiana during the three months ending June 30 of 1910 and 1911. The comparative record of casualties on the interurban railways as made by the commission follows:

	1910.	1911.
PASSENGERS.		
WHERE—		
On passenger trains	13	43
On station grounds	1	1
CAUSES—		
Collisions	4	18
Derailments	0	6
Getting on and off moving trains	8	8
Getting on and off trains after stops are made	0	0
Miscellaneous	2	12
RESULTS—		
Deaths	1	0
Fractures or dislocations	1	5
Sprains	2	3
Cuts and bruises	10	29
Miscellaneous	0	7
TRAVELERS ON HIGHWAYS.		
WHERE—		
Travelers on highways in vehicles	6	10
On foot	3	1
CAUSES—		
Struck on crossings	5	11
Teams frightened	2	0
Miscellaneous	2	0
RESULTS—		
Deaths	3	2
Sprains	1	1
Cuts and bruises	5	8
Miscellaneous	0	0
EMPLOYEES.		
EMPLOYMENT—		
Conductors	4	6
Motormen	1	5
Laborers	1	6
CAUSES—		
Collisions	3	6
Miscellaneous	1	7
Coupling and uncoupling	2	0
Getting on and off cars	0	4
RESULTS—		
Deaths	1	1
Fractures or dislocations	0	2
Sprains	0	2
Cuts and bruises	5	12
Miscellaneous	0	0
TRESPASSERS.		
WHERE—		
Trespassers on tracks	9	6
Miscellaneous	0	1
RESULTS—		
Deaths	5	5
Fractures or dislocations	1	1
Cuts and bruises	3	1
Collisions		4

Damage to property amounted to $2,295.00.
Derailments 1

Five-Cent Fare from East Bridgewater to Brockton.—The Bay State Street Railway has reduced the fare from East Bridgewater to Brockton from 10 cents to 5 cents between the hours of 6 and 8 a. m. and 4:30 and 6:30 p. m.

Brooklyn Bridge Rush-Hour Traffic Record Broken.—On Sept. 21, 1911, between the hours of 5 p. m. and 6 p. m. 364 surface cars were operated over the Brooklyn Bridge. This is the greatest number of cars ever run over the bridge in one hour.

Connecticut Company Asked to Reduce Fare on Interurban Line.—A petition has been filed with the Public Utilities Commission of Connecticut asking that the fare between Hartford and Manchester be reduced from 15 cents to 10 cents. The commission was to hear the petition on Oct. 10, 1911.

Electric Railways Within Jurisdiction.—In a decision by the Commerce Court the Interstate Commerce Commission is upheld in its decision that electric lines are amenable to the law when they do an interstate business. The case came to the court on appeal by the Omaha & Council Bluffs Railway & Bridge Company.

Chicago Elevated Railways to Control the Chicago & Milwaukee Electric Railway.—The Chicago Elevated Railways will secure control of the Chicago & Milwaukee Electric Railway, now held largely by Canadian interests represented by the Sovereign Bank of Canada, which has secured from Judge Grosscup two delays in entering a final decree of sale.

Safety Campaign in San Diego.—A campaign is being carried on in San Diego by Frederic S. Hughes under the auspices of the San Diego (Cal.) Electric Railway and the county schools to eliminate accidents which result from carelessness. Free illustrated lectures are being given before the school children and the railway employees.

Interurban Line Between Benton Harbor and Eau Claire.—Service was started on Sept. 26, 1911, on the new interurban railway of the Benton Harbor-St Joe Railway & Light Company from Benton Harbor to Dowagiac, which is an extension of the interurban railway operating between Benton Harbor and Eau Claire. Cars were run hourly to accommodate those who attended the Southern Michigan State Fair held in Benton Harbor.

Dayton, Covington & Piqua Traction Company Issue Commutation Ticket Books.—Beginning Sept. 25, 1911, the Dayton, Covington & Piqua Traction Company, West Milton, Ohio, introduced commutation ticket books, containing 100 5-cent coupons, which are sold for $4 at the ticket offices of the company. The mileage books were discontinued on the above date, but those mileage tickets which are outstanding will be honored on cars until Jan. 1, 1912.

Cleveland Railway Extension.—City Solicitor Baker has advised the City Council that the establishment of service on Central Avenue between East Ninth Street and East Fourteenth Street will not be in the nature of an extension of service, as the grant made to the Neutral Street Railway, taken over by the Cleveland Railway, called for the operation of cars on this portion of the street. The City Council may now take whatever action it sees fit upon the request of property owners in that section to establish the desired service.

Employees' Association Plans to Increase Benefits.—The Employees' Mutual Benefit Association, composed of employees of the Syracuse (N. Y.) Rapid Transit Company, plans to increase the death benefit from $150 to $200. The present time limit of ninety days for sick benefits of $1 a day will be increased to $1 a day for three months, at the expiration of which time 85 cents a day will be paid for a length of time to be agreed upon. The association had a surplus of $4,264 in its treasury when the September report was made.

Service Insignia Presented to Platform Men.—The Danbury & Bethel Street Railway, Danbury, Conn., has presented the motormen and conductors in its employ with service stars and stripes, graduated according to their respective years of employment with the company. The insignia consist of gold stars, silver stars and blue broadcloth stripes. One stripe is given each year up to five years, and when the employees have completed five full years they are given silver stars. For each ten years a gold star is given.

Traffic in St. Louis.—Statistics for eight months ended August, 1911, prepared by the auditing department of the United Railway, St. Louis, Mo., show that the density of traffic is greatest on the Grand line, while the largest number of transfers is used on the Tiffany line. Density of traffic is greatest on the Grand, Jefferson, Taylor, Laclede, Park and Vandeventer lines and lightest on the Clayton, Brentwood, Kirkwood-Ferguson, Florissant. The proportion of transfers is 67.30 per cent on the Tiffany line, 58.28 on the Taylor, 56.65 on the Marcus, 50.28 on the Hamilton, 49.65 on the Grand and 46.47 on the Union. Fewer transfers are offered on the Clayton line than any, its percentage being 9.23.

Key Route Folder.—The San Francisco, Oakland & San José Consolidated Railway, Oakland, Cal., the Key Route, has issued a very attractive folder in which the territory that is served by its lines is described and illustrated. The outside cover, which is in colors, is decorated with an illustration of one of the ferryboats of the company that ply between Oakland and San Francisco, and with an illustration showing one of the trains of the company in operation. On opening the publication there is unfolded a double-page bird's-eye view of San Francisco Bay and surroundings, showing the location of Oakland, Berkeley, Alameda, Richmond, the cities of the mainland, San Francisco and the peninsula. There is also a similar bird's-eye view in colors in the center of the pamphlet, but this is confined to the territory served by the Key Route.

New Officers of the Associations

In the daily edition of the Electric Railway Journal for Oct. 13, 1911, a portrait and biography were published of Thomas N. McCarter, president of the Public Service Corporation of New Jersey, who has been elected president of the American Electric Railway Association. Portraits and biographies are now published of P. S. Young, the new president of the American Electric Railway Accountants' Association; E. O. Ackerman, the new president of the American Electric Railway Engineering Association; H. K. Bennett, the new president of the American Electric Railway Claim Agents' Association, and J. N. Shannahan, the new president of the American Electric Railway Traffic & Transportation Association.

P. S. Young

E. O. Ackerman

Mr. P. S. Young, who was elected president of the American Electric Railway Accountants' Association at the annual meeting held at Atlantic City, N. J., this week, is the comptroller of the Public Service Railway, of Newark, N. J. He is also the comptroller of the Public Service Corporation, by which the railway system is controlled, and of the Public Service Electric Company and the Public Service Gas Company, other subsidiary companies of the corporation. Mr. Young has served as an official of the Accountants' Association and on committees during the last few years. In 1906 he was first vice-president of the association. In the last two years he has been co-chairman of the joint committee on shop accounting of the Accountants' and Engineering Associations. Mr. Young has also contributed papers before the Accountants' Association, discussing the subject of accounting for capital expenditures in one year and the accounting methods of a holding company in another year. Mr. Young became identified in 1890 with a constituent company of the United Gas Improvement Company in Omaha, Neb. He remained in that city until 1895, when he went to the main office of the United Gas Improvement Company in Philadelphia. In 1897 he went to Jersey City, N. J., as assistant agent of the United Gas Improvement Company. When the Hudson County Gas Company was formed two years later, Mr. Young was made assistant treasurer. In the following year, in addition to this office, he was elected secretary of the company. He continued in that position until 1903, when the Public Service Corporation of New Jersey was formed and acquired, among various other properties, control of the Hudson County Gas Company. Because of his connection with the various classes of public utilities in which the Public Service Corporation is interested, and his interest in the industries, Mr. Young is a member of numerous associations, including in addition to the American Electric Railway Accountants' Association, the National Electric Light Association, the American Gas Institute, the National Commercial Gas Association, the Illuminating Engineering Society and the Electric Vehicle Association of America.

E. O. Ackerman, the new president of the American Electric Railway Engineering Association, was born in 1862. He was graduated from the Ohio State University in 1884. His first engineering work was with the Ohio State Railroad Commission as inspector of bridges. Later he was appointed deputy surveyor of Van Wert County. From 1887 to 1888 he was assistant engineer on the Northern Pacific Railroad. From 1889 to 1890 he served as United States deputy mineral surveyor for the district of Montana. Returning to Ohio, Mr. Ackerman was employed in the engineering office of the Baltimore & Ohio Railroad for several years. His first electric railway experience was with the Columbus (Ohio) Street Railway. He entered the employ of this company in 1895 and has continued with the Columbus street railway since that time. His present position with the Columbus Railway & Light Company is of engineer maintenance of way.

Mr. H. K. Bennett, the new president of the American Electric Railway Claim Agents' Association, was born in Whitehall, N. Y., in 1871. He has lived in Fitchburg, Mass., for the last thirty-nine years and was educated there and was graduated from Boston University. He took up newspaper work in Fitchburg in 1891. In 1898 he entered the employ of the Fitchburg & Leominster Street Railway as carhouse foreman and dispatcher. He held this position for six years, when he was placed in charge of the claim department, publicity and advertising, which positions he has held ever since. Mr. Bennett is active in civic affairs in Fitchburg and was a member of the Common Council for the five years ended Jan. 1, 1911, and during his last year he served also as president of the Council. He began attending electric railway conventions with the Columbus meeting in 1906 and has been a regular delegate ever since. He was made third vice-president of the Claim Agents' Association in 1909 and first vice-president in 1910. Mr. Bennett's newspaper training has stood him in good stead as a contributor of papers before the association and to the technical press.

Mr. J. N. Shannahan, the new president of the American Electric Railway Transportation & Traffic Association, is railway manager of the operating department of J. G. White & Company, Inc., New York, N. Y. Mr. Shannahan has always taken a prominent part in association activities during his connection with electric railway work. He was president of the Street Railway Association of the State of New York during 1906-1907 and served as chairman of the committee on interurban rules of the American Electric Railway Transportation & Traffic Association during 1906-1907 and 1908-1909, and has been first vice-president of that association during the last year. After he was graduated from Rensselaer Polytechnic Institute in 1894 Mr. Shannahan entered the employ of the United States government as a draftsman on the Watervliet Arsenal. He served nine months in this position, and then entered the service of the New York Central & Hudson River Railroad at Rochester, N. Y., as inspector of signals. After several years' service with that company he became connected with the Fonda, Johnstown & Gloversville Railway as chief engineer. About this time the Fonda, Johnstown & Gloversville Railway was being partially equipped for electric operation and during the next four years Mr. Shannahan had charge of building the double-track electric railway between Gloversville and Schenectady for this company, and the single-track line between Amsterdam and Hegeman. On Jan. 1, 1903, Mr. Shannahan was appointed general superintendent of the company, in charge of both steam and electric operation, and at the same time was

H. K. Bennett

J. N. Shannahan

appointed manager of the Edison Electric Light & Power Company, Amsterdam. Early in 1904 he was elected president of the Adirondack Company. In 1907 Mr. Shannahan resigned as general superintendent and purchasing agent of the Fonda, Johnstown & Gloversville Railway, and as president of the Adirondack Lakes Traction Company, Gloversville, to become general manager of the Washington, Baltimore & Annapolis Railway, then under construction between Washington, Baltimore and Annapolis, and continued with the last-named company until May, 1911, when he resigned the positions of vice-president and general manager of the company to become railway manager of the operating department of J. G. White & Company, Inc., New York, N. Y.

Personal Mention

Mr. W. H. Pape has resigned as manager of the Pittsburgh & Butler Street Railway, Pittsburgh, Pa., and the Butler Passenger Railway, to engage in business for himself.

Mr. C. D. Beebe, first vice-president of the Rochester, Syracuse & Eastern Railroad, Syracuse, N. Y., has been elected president of the company to succeed L. C. Smith, deceased.

Mr. R. K. Page has resigned his position of local manager of the Portland Railway & Light Company. Mr. Page will remain in Salem and give his attention to private affairs. Mr. W. M. Hamilton, of Portland, Me., will succeed Mr. Page.

Mr. W. H. Martin has resigned as superintendent of transportation of the Orange County Traction Company, Newburgh, N. Y., to become connected with the Hicks & Johnson Company, which is doing part of the work at Cold Spring on the New York City water supply contract.

Mr. R. N. Hemming, who has been connected with the Ohio & Southern Traction Company, Columbus, Ohio, as general manager, has been appointed superintendent of motive power for the Indiana Traction Company, Anderson, Ind., to succeed Mr. W. H. Evans, who resigned Sept. 1.

Mr. Edward P. Burch, consulting engineer, Minneapolis, Minn., is spending eight weeks in Europe in a study of the application of electric traction to railroad train service, particularly on the state railways in France, Switzerland, Italy, Austria and Germany, and the steam railroad terminal electrifications in the larger cities.

Mr. Charles C. Tennis has been elected vice-president of the Pittsburgh & Butler Street Railway, Pittsburgh, Pa., and the Butler Passenger Railway in charge of operation. Mr. Tennis is a native of Juniata County, Pa., and for some years has been actively engaged in the construction and operation of electric railways in Pennsylvania, Ohio, Indiana and Kentucky.

Mr. C. E. Palmer has been appointed superintendent of transportation of the Ft. Wayne & Northern Indiana Traction Company, with headquarters in Ft. Wayne, Ind. Mr. Palmer has recently been superintendent of the Chicago, Lake Shore & South Bend Railway, Michigan City, Ind. Prior to his connection with that company Mr. Palmer was with the Ohio Electric Railway and still earlier with the Cleveland Construction Company at Cleveland. Since the resignation of Mr. Frank I. Hardy, several months ago, Mr. A. A. Kartholl, general freight and passenger agent of the Ft. Wayne & Northern Indiana Traction Company, has been acting as superintendent of transportation.

Mr. Mason B. Starring, heretofore president of the Northwestern Elevated Railroad, Chicago, has been elected president of the United Railways Investment Company, San Francisco, Cal., to succeed Mr. Ernst Thalmann, of the firm of Ladenburg, Thalmann & Company, New York, N. Y. Mr. Starring was born and educated in Chicago and has been in the railway business since early youth. He began his career in the operating department of the Chicago, Burlington & Quincy Railroad and was also connected with the Pennsylvania Railroad. In 1888 he became connected with the Chicago City Railway as a clerk. He was subsequently transferred to the office of Judge J. S. Grinnell, general counsel of the company, and in 1894 was made assistant general counsel. On May 12, 1904, he was made general manager of the company. Later he was elected vice-president of the company. In April, 1907, Mr. Starring was elected president of the Northwestern Elevated Railroad.

OBITUARY

Charles W. Johnson, president of the Acme Indicator Company, prominent in Cleveland military circles and well known in Cleveland as an industrial promoter, is dead.

August Stavenow, traffic manager of the Grosse-Berliner Strassenbahn, Berlin, Germany, died on Sept. 23, 1911, at his home in Schöneberg at the age of fifty-one years. Mr. Stavenow was a leading authority on German city transportation problems and was also a keen student of electric railway traffic in other countries. During 1906 he made an extended tour of the larger American cities and before leaving this country wrote an article, "Tabulation of Traffic Statistics in Berlin," which was published in the Street Railway Journal for May 19, 1906. Mr. Stavenow possessed great originality in analyzing traffic conditions, and his charts and models proved interesting exhibits at various congresses and expositions. Mr. Stavenow is survived by two daughters and three sons.

NEW PUBLICATIONS

Train Rule Examinations Made Easy. Compiled by G. E. Collingwood, New York, 1911. The Norman W. Henley Publishing Company. Cloth, 256 pages. Price, $1.25.

This book, which is of pocket size, is devoted to an explanation and elucidation of the standard code of train rules for single-track operation of the American Railway Association.

Hendricks' Commercial Register of the United States. S. E. Hendricks Company, New York, 1911. Cloth, over 1600 pages. Price $10. Express charges prepaid.

Purchasing agents are naturally well acquainted with the names and addresses of the manufacturers of the more important articles used by their companies, but even the most experienced buyer occasionally has difficulty in filling requisitions for unusual material. In such cases a commercial register of this kind is a decided help. The new edition represents about 350,000 names and addresses in more than 45,000 classifications. The supplementary list of common trade names is a feature which will aid in finding the manufacturers of articles known only by such designations.

Direct and Alternating Current Manual. Compiled by Frederick Bedell, professor of applied electricity in Cornell University, assisted by Clarence A. Pierce, Ithaca, N. Y., 1911. The D. Van Nostrand Company. Cloth, 360 pages. Price, $2.

This manual contains a series of tests on direct and alternating current apparatus, selected with reference to their practical usefulness and instructive value. From the text proper are excluded specialized tests and those that are of limited application or require unusual testing facilities, but these tests are described in the appendices to the several experiments. The book is fully illustrated with charts of connections, characteristic curves, vector diagrams and other explanatory figures.

Electric Traction and Transmission Engineering. By Samuel Sheldon and Erich Hausmann, New York, 1911. D. Van Nostrand Company. Cloth. 301 pages and 127 illustrations. Price, $2.50 net.

One of the most commendable features of this book is its entire absence of trade descriptions. The authors have arranged in logical order the principal problems which the electrical engineer must solve in deciding upon the size of the generating and distributing system and the number and capacity of the car equipments. The explanations are illuminated by practical examples which will enable the reader to apply the same methods to his own problems. Simple algebraic equations are used throughout except in problems relating to wave propagation, where hyperbolic functions have been used. The comparisons of various types of d.c. and a.c. motors and control and the studies in energy consumption are especially timely.

Construction News

Construction News Notes are classified under each heading alphabetically by States.

An asterisk (*) indicates a project not previously reported.

RECENT INCORPORATIONS

***Twin Falls (Idaho) Railway.**—Incorporated in Idaho to build electric and steam railways in the vicinity of Twin Falls. Capital stock, $500,000. Incorporators: L. B. Perraine, Twin Falls; Raymond McCune, E. S. Williams, D. B. Moorman, C. W. Smith and A. D. Stafford.

Oak Hill Street Railway, Chicago, Ill.—Incorporated in Illinois to build an electric railway in Chicago and suburbs. Capital stock, $20,000. Incorporators: Charles Pullman, I. A. Isaacson and L. S. Watts.

***Cuyuna Northern Railway, Deerwood, Minn.**—Incorporated in Minnesota to build an electric railway from Sherwood through Crow Wing County to a point on the Mississippi River. Capital stock, $1,000,000. Incorporators: Cuyler Adams, F. S. Adams and C. C. Adams, all of Deerwood.

Coraopolis & Sewickley Railway, Coraopolis, Pa.—Application for a charter has been made in Pennsylvania by this company to build an electric railway in Coraopolis, Moon and Sewickley. Incorporators: S. L. Tone, W. B. Carson, C. S. Mitchell, A. W. Stevenson and J. L. Foster. [E. R. J., Sept. 24, '11.]

Iowa, Nebraska & Dakota Railway, Pierre, S. D.—Application for a charter has been made in South Dakota by this company to build a 225-mile electric railway from Valentine, Neb., to Sioux City, Ia., via the counties of Cherry, Keyapaha, Boyd, Knox, Cedar and Dixon, Neb., the counties of Tripp and Gregory, S. D., and the county of Woodbury, Ia. It is proposed to utilize the water of the Niobrara River and the Keyapaha River for power purposes. Capital stock, $500,000. Headquarters: Pierre, S. D. Incorporators: C. H. Cornell, W. E. Haley and J. H. Bachelor, of Valetine, Neb.; Glenn W. Martens, Carl Goldsmith, J. R. McKnight and A. P. Edgar, of Pierre, S. D. [E. R. J., May 28, '10.]

***Dunbar & Wausaukee Railway, Wausaukee, Wis.**—Incorporated in Wisconsin to build a 14-mile railway from Wausaukee to Girard Junction, with a 12-mile extension to Dunbar. Capital stock, $150,000. Incorporators: J. W. Wells, Menominee, Mich.; C. B. Culbertson, Detroit, and J. A. Kenilworth, Illinois.

FRANCHISES

Phoenix, Ariz.—The Salt River Valley Electric Railway, Phoenix, has asked the City Council for a franchise in Phoenix. This 60-mile railway will connect Phoenix, Ingleside, Scottsdale, Tempe, Mesa, Chandler, Alhambra, Glendale and Peoria. F. M. Winter, Phoenix, president. [E. R. J., Aug. 26, 1911.]

Riverside, Cal.—The City Council will receive bids for the sale of the franchise for the construction of an electric railway over Magnolia Avenue, in Riverside. The Pacific Electric Railway, Los Angeles, has offered $25,000 for it.

Denver, Col.—The Denver City Tramway has received a franchise from the Council of Park Hill Heights to extend its tracks along Colorado Boulevard and East Twenty-ninth Avenue to Park Hill Heights.

Averyville, Ill.—The Peoria Northern Railway, Peoria, has asked the Council for a fifty-year franchise in Averyville. This line will connect Peoria, Mossville, Rome, Chillicothe, Sparland, Henry and Bureau Junction. H. E. Chubbuck, Peoria, president. [E. R. J., June 10, 1911.]

Averyville, Ill.—The Peoria Railway Terminals Company has asked the Board of Trustees for a franchise in Averyville. The line is to be double tracked.

Ottawa, Ill.—The Chicago, Ottawa & Peoria Railway, La Salle, has asked the City Council for a franchise to double track some of its lines in Ottawa.

Indianapolis, Ind.—The Indianapolis Traction & Terminal Company has asked the Board of Public Works for an extension of time on its franchise in which to complete the improvements of its tracks in Indianapolis.

***Vincennes, Ind.**—L. A. Meyer, C. B. Kessinger, Frank Bastin and associates have asked the Board of Trade directors for a franchise to build an electric railway from Vincennes to South Vincennes.

Beverly, Mass.—The Boston & Eastern Electric Railroad, Boston, has received a franchise from the Aldermen in Beverly and from the Aldermen in Salem. The company has asked the City Council of Lynn for a franchise to build its tracks through Lynn.

Springfield, Mass.—The Berkshire Street Railway, Pittsfield, has asked the Aldermen for a franchise to connect its Pittsfield and Berkshire lines at the south side of the park in Springfield.

Minneapolis, Minn.—The Twin City Rapid Transit Company, Minneapolis, has asked the City Council for franchises to build a number of extensions of its railway lines in Minneapolis.

Laurel, Miss.—S. M. Jones and P. H. Saunders, Laurel, have received a twenty-five-year franchise from the City Council to operate an electric railway and power plant in Laurel. Part of the stipulation of the franchise at Laurel is that this line must be in operation by April 1, 1912. The line will then be extended to Ellisville. [E. R. J., Oct. 7, 1911.]

Manchester, N. H.—The Manchester Street Railway has asked the Mayor and Aldermen for a franchise to relocate and extend some of its tracks in Manchester.

Trenton, N. J.—The franchise granted by the City Council of East Orange, giving the Public Service Railway permission to operate a line on North Park Street, has been approved by the Board of Public Utility Commissioners.

Cincinnati, Ohio.—The Cincinnati Traction Company has asked the City Council for a franchise to extend its Avondale Street line to Bond Hill.

North Dayton, Ohio.—The People's Railway, Dayton, has asked the Council for a franchise to extend its tracks in North Dayton.

Oklahoma City, Okla.—The Oklahoma Interurban Traction Company has had sustained in the Supreme Court the validity of the franchise granted it to build its tracks on any street in Oklahoma City not in use by the Oklahoma Railway.

Spartanburg, Pa.—The Greenville, Spartanburg & Anderson Railway, Greenville, has asked the City Council for a franchise over certain streets in Spartanburg.

Spring City, Pa.—The Pottstown & Reading Street Railway, Pottstown, has asked the City Council for a franchise in Spring City. This is part of a plan to build a line between Spring City and Sanatoga.

Dallas, Tex.—The Southern Traction Company, Dallas, has asked the Mayor and Commissioners for a franchise inside the city limits of Dallas. This line will connect Dallas, Waco, Hutchins, Ferris, Waxahachie, Milford, Hillsboro and Forreston. J. F. Strickland, president. [E. R. J., Aug. 26, '11.]

***Bingham City, Utah.**—Judge Watson and associates have received a franchise from the City Council in Bingham City. This is part of a plan to build an electric railway through the Bear River Valley and eventually extend it to Malad, Idaho.

Richmond, Va.—The Virginia Railway & Power Company has asked the City Council for a franchise to extend its tracks in Richmond from Robinson Street to West Street and thence to Floyd Avenue, forming a loop.

Vancouver, Wash.—H. L. Harmon and E. R. Ernsberger have asked the City Council for a franchise in Vancouver. This is part of a plan to build an electric railway from Vancouver north to the South Fork of the Lewis River, thence northeast to Klickitat Pass, a distance of 100 miles. [E. R. J., Sept. 30, '11.]

Weston, W. Va.—The Fairmont & Clarksburg Traction Company, Fairmont, has asked the City Council for a franchise in Weston.

Weston, W. Va.—The Clarksburg & Weston Electric Railway, Clarksburg, will ask the City Council for a franchise in Weston,

TRACK AND ROADWAY

Tucson (Ariz.) Rapid Transit Company.—A 1-mile extension is being planned by this company at Tucson from the University gate to the Speedway and thence down the Speedway.

Clear Lake Railroad, Lakeport, Cal.—The directors of this company have authorized the construction of 9 miles of roadbed. Contracts will be let at once for 4 miles of grading out of Hopland and 5 miles southwest of Lakeport. This 24-mile line will extend from Hopland to Lakeport, with branches through Kelseyville and Upper Lake. E. Howard, Lakeport, secretary. [E. R. J., June 10, '11.]

Sacramento & Woodland Railway, Sacramento, Cal.—Bids are being received by this company for grading on the line which will connect Sacramento and Woodland and contracts will be awarded soon. The grading bids were let in three sections.

Sacramento Valley West Side Electric Railway, Sacramento, Cal.—Preliminary surveys are being made and franchises will soon be asked for by this company for its railway between Woodland, Colusa, Willows, Orland, Corning, Redding and Red Bluff. C. L. Donohoe, Willows, president. [E. R. J., Aug. 19, '11.]

Denver (Col.) City Tramways.—This company plans to build an extension along Colorado Boulevard and Twenty-ninth Avenue in Denver.

Pueblo & Suburban Traction & Lighting Company, Pueblo, Col.—During the next few weeks this company will place contracts to build about 6 miles of new track and two concrete bridges.

Trinidad Electric Transmission Railway & Gas Company, Trinidad, Col.—During the next four weeks this company will place contracts for rebuilding about 19 miles of track.

Shore Line Electric Railway, New Haven, Conn.—This company has awarded the contract to build an extension between Ivoryton and Deep River to the Cavanaugh-McCaffrey Company, Boston. Preliminary work has been begun. It is expected that this line will be extended to Chester as soon as the right-of-way can be obtained.

Valparaiso & Northern Railway, Valparaiso, Ind.—This company's line is practically completed from Valparaiso to Chesterton and will soon be ready for operation. Some bridge work remains to be completed.

***Carrollton, Ky.**—James Gayle, general manager of the Carrollton & Worthville Railroad, with headquarters at Carrollton, Ky., is reported to be interested in a line between Carrollton and Covington, Ky., a distance of 55 miles.

Kentucky Southwestern Railway, Light & Power Company, Hickman, Ky.—This company is now making a preliminary survey for its proposed line between Paducah, Ky., and Union City, Tenn. Following the survey it is the intention to interest outside capital in the construction of the line, the estimated cost of which is $4,000,000. W. A. Calhoun is in charge of the survey. [E. R. J., Oct. 8, '11.]

Norway & Paris Street Railway, Norway, Maine.—This company has let the contract to C. E. Hoxie & Company, of Augusta, for the construction of a new concrete dam at the outlet of Pennesseewassee Lake, Norway, Maine. The dam is to be completed before the winter. The site is that of a storage dam on the largest of the three bodies of water at a distance above the power site.

Aroostook Valley Railroad, Presque Isle, Maine.—This company is said to have effected a contract with the New Brunswick provincial government for the construction of the St. John Valley Railroad along the St. John River from St. John to Grand Falls and St. Leonards. The proposed new line is to have a subsidy from the Canadian government.

Boston (Mass.) Elevated Railway.—Plans are being considered by this company to extend its line from Maplewood across the east side of Melrose through Lebanon Street to Porter Street.

Ironwood & Bessemer Railway & Light Company, Bessemer, Mich.—Work will soon be begun by this company on its 27-mile electric railway to connect Melles Falls, Ashland, Ironwood and Bessemer. F. Sullivan, Ironwood, is interested. [E. R. J., Sept. 24, '11.]

Twin City Rapid Transit Company, Minneapolis, Minn.—Work has been begun by this company on the extension of its Johnson Street line in Minneapolis to Twenty-seventh Avenue N. E.

St. Paul Southern Electric Railway, St. Paul, Minn.—This company has consolidated with the Interurban Construction Company, of Hastings, Minn., and let the contract to Hoy & Elzy Company for the construction of an electric railway to Mankato. [E. R. J., July 15, '11.]

Gulfport & Mississippi Coast Traction Company, Gulfport, Miss.—Plans are being figured on by this company for substantial improvements and betterments as well as some extensions of its lines in the near future.

West Missouri Electric Railway, Kansas City, Mo.—This company has awarded a contract to the Spitcaufsky-Wagner Construction Company to build the 3-mile section of this line from Kansas City southeasterly. It will connect Kansas City and Warrensburg via Lee Summit, Grandview, Belton and Roymore. The company will build no power house. It will purchase its electric power from the Metropolitan Street Railway and the present intention is to lease Metropolitan cars at first. [E. R. J., May 6, '11.]

Whitefish & Polson Electric Railway, Kalispell, Mont.—It is reported that this company has made arrangements to finance the line from Whitefish to Kalispell. It is expected to begin work this fall. The directors of the company have sold and assigned all their rights-of-way and franchises for an electric line through Kalispell to the Flathead Interurban, which is being backed by D. R. McGinnis, a local capitalist. [E. R. J., Feb. 4, '11.]

Binghamton (N. Y.) Railway.—This company has under construction a mile of new track in Binghamton, for which materials have been purchased.

Orange County Traction Company, Newburg, N. Y.—About 1½ miles of track are being renewed by this company on Holden Street and Water Street in Newburg. A concrete foundation and a reinforcement of brick are being laid.

***Devils Lake, N. D.**—R. F. McDougall, St. Paul, and associates are planning to build an electric railway between Devils Lake, Greenwood and Chautauqua.

Cleveland, Southwestern & Columbus Railway, Cleveland, Ohio.—Work has been begun by this company double tracking its Broad Street line in Cleveland.

Oklahoma Interurban Traction Company, Oklahoma City, Okla.—Work is under way by this company on its Harvey Avenue line and the downtown loop on Main Street and Grand Avenue in Oklahoma City. Plans are being considered to build an extension south and west from Fifth Street to connect with the north end of the Patterson Capitol Hill line at Hudson Avenue.

London (Ont.) Street Railway.—Extensive improvements are being planned by this company for its lines in London. It is expected that about $1,000,000 will be expended.

Hummelstown & Campbellstown Street Railway, Hershey, Pa.—The Pennsylvania Steel Company has received an order for 1000 tons of rails from this company.

Mahoning & Shenango Railway & Light Company, New Castle, Pa.—Work has been begun by this company on the extension of the Elm Street line in Warren.

West Penn Railways, Pittsburgh, Pa.—About $2,000,000 will be spent by this company in improvements and extensions of its lines in western Pennsylvania. The new extensions will include one from Greensburg to New Alexandria and another from New Alexandria to Latrobe, and a third to cover a territory between West Newton and Scott Haven. Rights-of-way have been acquired between the terminals for these projections and surveys are being made.

Somerset (Pa.) Railway.—Work will be begun shortly by this company on its 10-mile electric railway between Somerset and Rockwood. C. C. Winslow, Somerset, general manager. [E. R. J., May 13, '11.]

***Rapid City, S. D.**—Efforts are now being made by local business men who are connected with interested capital to complete plans for a forty-seven-mile electric railway from Rapid City to Newell in Butte County.

Jackson Railway & Light Company, Jackson, Tenn.—

This company has begun work on an extension from Pearl Street to Porter Street.

***Shawanee, Tenn.**—It is reported that a company is being organized for the purpose of establishing a hydroelectric power plant on Powell's River, near Shawanee. The purpose of the development is to furnish power for Jellico, Tenn., and Middlesboro, Ky. It is also the plan to operate an electric railway in that territory.

Ft. Worth Southern Traction Company, Ft. Worth, Tex.—The route of this electric railway will extend from Dallas to Waco and from Dallas to Corsicana, via Ferris, the lines to diverge at Ferris, approximately a total distance of 134 miles. Beginning at Dallas, it is contemplated to have the route extend via Hutchins and Wilmer to Ferris, thence to Waco, through Rockett, Waxahachie, Forreston, Italy, Milford, Hillsboro, West Elm Mott and Day's Lake. The Corsicana line, diverging at Ferris, is to run via Trumbull, Palmer, Garrett, Ennis, Alma and Rice. G. H. Clifford, Ft. Worth, is interested. [E. R. J., Oct. 7, '11.]

Northern Texas Traction Company, Ft. Worth, Tex.—This company has placed in operation its new extension known as the Forest Park line, which extends from Forest Park to the Texas Christian University.

Galveston (Tex.) Electric Company.—Plans are being made by this company for the construction of new cross-town lines in Galveston, east of Twenty-first Street.

San Benito (Tex.) Interurban Railway.—Within the next few months this company will extend its tracks to Santa Maria. Preliminary arrangements are now being made.

Virginia Railway & Power Company, Richmond, Va.—It is reported that this company will spend $1,100,000 within the next year for enlarging and improving its lines. About $200,000 will be spent on track work.

Highland Park & Lake Burien Railway, Seattle, Wash.—Dibble-Hawthorne & Company, Tacoma, have secured the contract for constructing the 7-mile electric line from Oxbow to Lake Burien for this company. W. H. Coughlin, 302 American Bank Building, Seattle, is interested. [E. R. J., Sept. 9, '11.]

Spokane & Inland Empire Railroad, Spokane, Wash.—This company will extend its North Howard Street line in Spokane to the city limits at once.

Steubenville, Wellsburg & Weirton Railway, Charleston, W. Va.—The branch of this railway which connects Weirton and Steubenville has been placed in operation.

Fairmont & Clarksburg Traction Company, Fairmont, W. Va.—Plans are being considered by this company to build an extension to Smithtown with a spur extending to Montana. This line will eventually extend to Morgantown.

Mount Morris-Morgantown Traction Company, Morgantown, W. Va.—Stockholders of this company have decided to dissolve the company and abandon the proposed line from Mount Morris to Maidsville and Randall. Aaron Garlow, Morgantown, president. [E. R. J., Aug. 26, '11.]

Morgantown (W. Va.) Interurban Railway.—It is reported that a meeting will soon be held for the organization of this company and that surveys will be made this fall to build an electric railway between Fairmont and Morgantown, via Laurel, Point Georgetown, Arnettsville and Riversville. J. H. McDermott, president. [E. R. J., July 29, '11.]

Wheeling (W. Va.) Traction Company.—Plans are being considered by this company for the construction of an extension from Moundsville to Barton and St. Clairsville.

Milwaukee Western Electric Railway, Milwaukee, Wis.—Work has been begun by this company on its line between Juneau and Hustisford.

Badger Railway & Light Company, Milwaukee, Wis.—This company advises that its proposed line will connect Whitewater and Lake Geneva via Elkhorn. The company has not placed in operation a line between Pewaukee and Watertown as was reported in the Electric Railway Journal, Sept. 23. [E. R. J., Sept. 23, '11.]

SHOPS AND BUILDINGS

Denver City Tramway Company, Denver, Col.—This company has broken ground for the new car repair shops, paint shops and garage at Thirteenth Street and Arapahoe Street, in Denver. The divisions will be separate fireproof buildings, and will open off the new fireproof carhouse at Thirteenth, Fourteenth and Arapahoe Streets, just completed by this company.

Trinidad Electric Transmission, Railway & Gas Company, Trinidad, Col.—During the next four months this company will place contracts to build a steel-frame extension to its carhouse in Trinidad.

Terre Haute, Indianapolis & Eastern Traction Company, Terre Haute, Ind.—The plans for the new traction terminal station and arcade building have been received by General Manager T. F. Glover, of this company, and bids for the construction of the building are being advertised for. The building will be of steel, stone and brick. The station proper will be a six-story fireproof building in the rear of the Arcade. The train sheds will run through the length of the building. The basement will be finished for occupancy.

Gulfport & Mississippi Coast Traction Company, Gulfport, Miss.—Work has been begun by this company on a new repair shop in Gulfport.

Interurban Railway & Terminal Company, Cincinnati, Ohio.—Plans are being made by this company to rebuild its carhouse which was recently destroyed by fire at Coney Island. A temporary structure will be erected. The company is considering plans for a consolidation of its power plants and carhouses.

Cincinnati (Ohio) Traction Company.—This company proposes to build its new carhouse at Erie Avenue and Tarpis Street, in Cincinnati. The structure will be one story in height and of concrete construction. The cost is estimated to be about $60,000.

Philadelphia & West Chester Traction Company, Upper Darby, Pa.—A new freight station and warehouse is being built by this company at Milltown at the east end of the bridge over Chester Creek.

Virginia Passenger & Power Company, Richmond, Va.—New steel carhouses to cost $125,000 and the erection of terminals at Ocean View and Willoughby are among the improvements planned by this company in the near future.

POWER HOUSES AND SUBSTATIONS

Pacific Electric Railway, Los Angeles, Cal.—This company has placed an order with the General Electric Company for one motor-generator set, one 17-kw, 500-125-volt exciter and three WC-450-15,000:13,500-2250-volt core type transformers.

Trinidad Electric Transmission Railway & Gas Company, Trinidad, Col.—During the next four weeks this company expects to purchase two 2000-kw turbines, three 1000-kw transformers, coal-handling machinery, boilers with a capacity of 1000 hp and stokers for its power plant at Trinidad.

Metropolitan West Side Elevated Railway, Chicago, Ill.—This company has placed an order with the General Electric Company for two 2000-kw, 600-volt rotary converters, six 700-kw, 9000:430 transformers, two 20,000-cu. ft. blower sets and a switchboard for its power house in Chicago.

Des Moines City Railway, Des Moines, Ia.—An order has been placed by this company with the General Electric Company for a switchboard for its power plant at Des Moines.

Lewiston, Augusta & Waterville Street Railway, Lewiston, Maine.—An order has been placed by this company with the General Electric Company for one 300-kw, 2--unit motor-generator set and a switchboard for its power plant at Lewiston.

Central Pennsylvania Traction Company, Harrisburg, Pa.—This company has purchased from the Hoover, Owens & Rentschler Company one Hamilton Corliss engine with a capacity of 1600 kw and one generator for same from the General Electric Company. This is now being erected in its power plant at Harrisburg. The company expects to purchase one 150-kw generator, one 150-kw booster and one engine from the Harrisburg Foundry & Machine Works.

Fairmont & Clarksburg Traction Company, Fairmont, W. Va.—This company has placed an order with the General Electric Company for three 300-kw, 1200:600-volt CW rotary converters, nine 110-kva transformers and a switchboard for its power house at Fairmont.

Manufactures & Supplies

ROLLING STOCK

Delaware & Hudson Company, Albany, N. Y., has ordered one gas-electric motor car from the General Electric Company.

Dayton & Troy Electric Railway, Dayton, Ohio, has ordered one double-truck McGuire-Cummings long-broom snow sweeper.

New York City Interborough Railway, New York, N. Y., has ordered two long-cab snow sweepers from The J. G. Brill Company.

Erie & Suburban Railway, Erie, Pa., has ordered one GE-205 four-motor equipment with K-34 control from the General Electric Company.

Stroudsburg (Pa.) Passenger Railway has ordered one 28-ft. convertible motor car body mounted on Brill 39-E trucks from The J. G. Brill Company.

Union Traction Company, Coffeyville, Kans., has ordered two 25-ft. 4-in. pay-within motor cars mounted on Brill 39-E trucks from the American Car Company.

Chicago (Ill.) City Railway has ordered three steel underframe single-truck, long-broom snow sweepers from the McGuire-Cummings Manufacturing Company.

Orange County Traction Company, Newburgh, N. Y., is to rebuild one car for pay-within operation and will be in the market for cars of this type if the experimental car meets the service requirements in Newburgh.

Clear Lake Railroad Company, Lakeport, Cal., is in the market for one self-contained car, either gasoline or storage battery, for passenger, mail and express service. Capacity twenty people and 2 tons of freight.

City & County Contract Company, New York, N. Y., has ordered one gasoline-electric equipment for construction car and control equipment for the New York, Westchester & Boston Railway, from the General Electric Company.

Salt Lake-Ogden Railway, Salt Lake City, Utah, has ordered one 30-ton electric locomotive mounted on McGuire-Cummings No. 70-A high-speed interurban trucks from the McGuire-Cummings Manufacturing Company.

Waterloo, Cedar Falls & Northern Railway, Waterloo, Ia., has ordered one 50-ft. baggage and express car mounted on McGuire-Cummings No. 70-A high-speed interurban trucks from the McGuire-Cummings Manufacturing Company. The car is equipped with four GE-73 motors and automatic air brakes.

Nashville-Gallatin Interurban Railway, Nashville, Tenn., is asking for bids, through the Fidelity Securities Corporation, Nashville, for four 50-ft. interurban steel passenger car bodies equipped for single-end operation, and one 50-ft. steel baggage car body equipped for double-end operation. H. H. Mayberry is president.

Union Electric Company, Dubuque, Ia., has specified that the six closed pay-as-you-enter motor cars ordered from the American Car Company shall be 31 ft. 1 in. long over all and 8 ft. 3¼ in. wide over all. They will be equipped with Curtain Supply Company's fixtures, pantasote curtains, National hand brakes, Consolidated heaters, United States headlights, GE 67-2 motors, International registers, Brill sanders, Hale & Kilburn seats, Mason step treads, Brill 21-E trucks and St. Louis car wheels.

Boston (Mass.) Elevated Railway has included the following details in the specifications for the fifty semi-convertible pre-payment cars being built by the St. Louis Car Company and the Osgood-Bradley Car Company:

Seating capacity 52	Fare boxes...recording reg.
Weight (car body)...21,000	Gears and pinions.....West.
Bolster centers, length.24 ft.	Hand brakes.....National
Length of body..34 ft. 4 in.	Heaters .....Consolidated
Over vestibule...46 ft. 10 in.	Headlights .....U. S.
Width over sills...8 ft. 7 in.	Journal boxes....Symington
Over all.....8 ft. 8¾ in.	Motors 4-West-306
Height, rail to sills....30 in.	Motors .....inside
Sill to trolley base..9 ft. 6 in.	Sanders .....Kilburn
Body .....composite	Seats ...St. Louis Wakefield
Interior trim....composition	Seating material .....wood
Roof .....monitor	Trolley catchers.....Wilson
Underframe .....steel	Trolley base .....Nuttall
Bumpers.Hedley anti-climber	Trucks.....Brill 27-MCB-1
Control.....West. Type HL	Ventilators .....Perry
Curtain fixtures....C. S. Co.	Special devices,
Curtain material...pantasote	door-operating mech.
Destination signs ...Hunter	

Lehigh Valley Transit Company, Allentown, Pa., noted in the Electric Railway Journal of July 22, 1911, as having ordered ten convertible pay-within cars from The J. G. Brill Company, has specified the following details for these cars:

Seating capacity.....44	Curtain material...pantasote
Weight (car body only),	Destination sign.....Hunter
19,000 lbs.	Fenders .....Providence
Bolster centers, length,	Gears and pinions.....solid
18 ft. 6 in.	Gongs .....Dedenda
Length of body..30 ft. 1 in.	Hand brakes.....Peacock
Over vestibule...42 ft. 1 in.	Heaters.....Peter Smith
Width over sills....8 ft. 8 in.	Headlights .....G. E.
Over all.....8 ft. 10 in.	Journal boxes....Symington
Sill to trolley base.12 ft. 1 in.	Motors .....4 West 101-B-2
Body .....wood	Motors .....inside
Interior trim.....mahogany	Paint .....Ry. Co. Std.
Headlining .....agasote	Registers .....Sterling
Roof .....Brill plain arch	Sanders .....Universal
Underframe .....wood	Sash fixtures.....Edwards
Air brakes.....West. D-2	Seats .....Winner
Axles...5-in. motor bearing;	Seating material .....rattan
6-in. gear seat	Springs .....Brill
Bumpers....Brill angle iron	Step treads .....Mason
Cables .....Brill	Trolley base.....U. S.
Car trimmings ....malleable	Trucks 27-MCB-1
Couplers .....Ry. Co.'s Std.	Wheels,
Curtain fixtures..Curt. S. Co.	F. S. W. Co. 34-in. rolled steel
Ventilators .....automatic	

TRADE NOTES

Chicago Pneumatic Tool Company, Chicago, Ill., has appointed the Holden Company, Montreal, Que., as its general sales agent in Canada.

Niles-Bement-Pond Company, New York, N. Y., has appointed the Canadian Fairbanks-Morse Company, Ltd., to act as its agents in Canada.

Westinghouse Air Brake Company, Pittsburgh, Pa., has elected Morris M. Rosenwald, of Chicago, to succeed George C. Smith as a director of the company.

Brown Hoisting Machinery Company, Cleveland, Ohio, has opened an office in the Commercial National Bank building, Chicago, Ill., with A. M. Merryweather as manager.

McKeen Motor Car Company, Omaha, Neb., has shipped a seventh standard 70-ft. all-steel motor car to the Oregon-Washington Railroad & Navigation Company at North Yakima, Wash.

Johnson Fare Box Company, Chicago, Ill., has received an order from the Kentucky Traction & Terminal Company for fare boxes to be installed on the pay-as-you-enter cars which are being placed in operation.

Detroit Twist Drill Company, Detroit, Mich., has appointed Halsted Little Eastern sales agent with offices at 30 Church Street, New York, N. Y. Mr. Little was associated for many years with the sales department of Manning, Maxwell & Moore.

Wagner Electric Manufacturing Company, St. Louis, Mo., has appointed P. L. Lewis as sales representative in Texas, with headquarters in the Scollard Building, Dallas, to take the place of J. A. Gelzer, who severed his connections with the company several months ago.

Coogan Engineering Company, Milwaukee, Wis., has received a contract from the Utah Light & Railway for an extension of the Coogan system of hot-water heating, which it installed in the main plant in 1909, for the purpose of heating the machine shops, paint shops, carpenter shop, blacksmith shop and storehouse.

Lindsley Brothers Company, Spokane, Wash., has opened a Canadian office at Calgary, Alta. G. U. Bacon has been placed in charge of the new office as resident manager and will push the company's "Pole-cat Brand" of cedar

poles throughout Canada. The company is also adding to its line the "Bear Brand" of cedar posts.

Lord Manufacturing Company, New York, has acquired all title, interest, rights, etc., formerly owned by the Spencer Air Purifying Company and has purchased the Spencer company outright. It will hereafter manufacture and sell the Spencer air purifier, Spencer air equalizer and all other appliances made by the absorbed company.

Corrugated Bar Company, St. Louis, Mo., has announced the removal of its headquarters from St. Louis, Mo., to Buffalo, N. Y., to take effect the 14th of this month. It will occupy the third and fourth floors of the Mutual Life Building in Buffalo. District offices will be maintained in the National Bank of Commerce Building at St. Louis, as well as in New York and Chicago.

United States Electric Company, New York, N. Y., announces that the Atlantic Coast Line Railroad, which has had for some time 167 of this maker's Gill selectors in service in five circuits on its telephone train-dispatching and message service, has received ninety-eight additional selector equipments which are being installed in extension of the system to Jacksonville, Fla.

J. G. Brill Company, Philadelphia, Pa., has received the following foreign orders: W. R. Grace & Company for two 20-ft. 8-in. prepayment center-aisle open motor car bodies, for F. C. Urbano de Lima, Lima, Peru. Okura & Company for ninety 21-E trucks for the Osaka Municipal Railway, Osaka, Japan. Ottawa Car Company for two 21-E trucks complete, with wheels and axles, for the Moose Jaw Electric Railway, Moose Jaw, Can. J. G. White & Company for eight 27-GE-1 trucks without wheels and axles for the Manaos Tramways, Manaos, Brazil.

Ohmer Fare Register Company, Dayton, Ohio, will build several reinforced concrete, fireproof factory buildings in Dayton. The contracts have been let and work has been begun. The buildings will be located in Edgemont on a 4½-acre tract of land recently acquired by the company on the main line of the Big Four Railroad. Robert E. Dexter has prepared plans for the main building, which will be 242 ft. long, 61 ft. wide and five stories high. Part of the first floor in the south end of the building will be used for the main offices. Provision will also be made for auxiliary offices, committee rooms, salesmen's meeting rooms and rooms fitted for drafting and experimental work. The new buildings will place the company in a position to manufacture several auxiliary devices, including a stop indicator, and a machine for printing transfers.

Ackley Brake Company, New York, N. Y., has just shipped an order of Ackley adjustable brakes to the Havana Electric Railway, Havana, Cuba. This road has now been furnished with 534 Ackley adjustable brakes. Other recent orders for this type of brake were for Campinas, Brazil; Buenos Aires, Rosario, LaPlata and Quilmes, Argentina; Charleroi, Belgium; Astrakan, Siberia; Kitchineff, Russia; Skoien, Norway, and Durban, Natal. Orders have been received also through the Compagnie Française des Freins Ackley for Ackley no-staff brakes for a number of roads in France and Spain, and the Deutsche Ackley Bremsen Company, M. B. H., of Berlin, has placed orders with the local company for no-staff brakes to be supplied to some of the largest tramways in Germany. No-staff brakes have also been furnished by the British Ackley Brake Company of London to several tramways in England.

ADVERTISING LITERATURE

Standard Roller Bearing Company, Philadelphia, Pa., has issued Bulletin No. 26, which describes the construction and the saving effected by the use of roller bearings.

Chicago Railway Equipment Company, Chicago, Ill., is distributing a relief map of the Panama Canal. The map is accompanied by a profile illustration of the canal with historical and descriptive notes.

Goldschmidt Thermit Company, New York, N. Y., has published the third quarterly number of "Reactions," which contains several very interesting articles on rail and industrial welds by the Thermit process.

Brown Hoisting Machinery Company, Cleveland, Ohio, has issued a pamphlet containing 45 pages of illustrations of installations of its locomotive cranes for a variety of uses and descriptions of possible uses to which they can be put.

Hess-Bright Manufacturing Company, Philadelphia, Pa., has issued sheets 72, 73 and 38B of its loose-leaf catalog describing its ball bearings for circular saws and jointing machines, woodshaper spindles and cranehook thrust bearings.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has issued folders Nos. 4215 and 4216, which describe a.c. and d.c. switchboard meters respectively. Another folder, No. 4217, describes and illustrates Westinghouse Type C watt-hour meters.

Zelnicker Crayon Works, St. Louis, Mo., has issued a catalog describing its different styles of marking crayons for use in car marking, for marking green and dry lumber and glass. These crayons do not stain the material marked and the mark does not wash or brush off.

H. M. Byllesby & Company, Chicago, Ill., have reprinted in booklet form an address entitled "The Regulation of Public Utilities," delivered by Arthur S. Huey, vice-president of the company, at the annual convention of the League of American Municipalities at Atlanta, Ga., on Oct. 5, 1911.

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued Circular 1131, describing graphic meters for switchboard service. The publication shows illustrations of the meters together with typical charts taken from same, indicating the various uses to which graphic meters may be put with advantage to the user.

De Laval Steam Turbine, Trenton, N. J., has issued a booklet entitled "A Steam Turbine for Driving Direct-Current Generators," which describes the De Laval multistage geared steam turbine for driving low or moderate speed machinery. It also contains a discussion of the different types of steam turbines and their comparative merits.

Sangamo Electric Company, Springfield, Ill., has issued Bulletin No. 19, which describes its ampere-hour meters for use in charging electric vehicles. Complete wiring diagrams for various types of well-known vehicles are given, and these should prove of assistance to managers who desire to equip to meet the conditions of vehicle charging service.

W. N. Matthews & Brother, St. Louis, Mo., have issued a booklet which describes the "Telafault." This instrument locates the following kind of telephone cable troubles: Dead shorts, high-resistance trouble (up to 50,000 ohms) and wet spots. It is asserted to be the only instrument that will locate grounds without "noising up" the other pairs in a working cable. It will find all kinds of faults except "opens."

Allis-Chalmers Company, Milwaukee, Wis., has issued several bulletins of interest to electric railway engineers. Bulletin No. 1068 gives an illustrated description and discussion of point of advantage of its direct-connected Corliss engine units. Bulletins No. 1070 and No. 1519 contain descriptions and sectional drawings of installations of its barometric condensers. Bulletins No. 1074 and 1083 describe direct-current motors and generators for individual machine drive and power-house units. Bulletin No. 1078 describes alternating-current generators for turbine and reciprocating steam engine use, for gas engines and belted units. Bulletin No. 1082 describes engine-driven, direct-current generators, including exciter and gas-engine units.

Green Fuel Economizer Company, Matteawan, N. Y., has issued a 94-page book entitled "Heating and Ventilating," which contains articles on the loss of head by friction through pipes, loss of head through orifices and equivalent orifices, method of determining the size of heaters to meet any given requirement and a method of calculating air resistances in parallel and series analagous to Ohm's and Kirchoff's laws, as applied to electrical circuits. There are also numerous new tables of constants which are of use in general engineering practice. The company has also published Bulletin No. 140, entitled "The Economy of Green's Economizers." Five articles reprinted from recent issues of technical journals are given which describe power-house installations in which Green's economizers are used. The bulletin also contains notes on economizer practice, giving data and formulas used in their installation.