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Of this issue of the ELECTRIC RAILWAY JOURNAL, DAILY EDITION, 10,000 *copies are printed.*

The Report on Equipment

The report of the committee on equipment this year, like that of last year, is an excellent example of what a report should be, but differs from that presented in Atlantic City last year because it consists largely of monographs, in most cases by members of the committee. Two valuable reports are included, however, from representatives of prominent manufacturers, on recent developments in electrical apparatus. All of the twelve subjects discussed in this report bear directly upon the cost of operation, and all are worthy of careful study. It will be impossible to consider all of them, but a few might be referred to at this time.

Mr. McAloney's paper and that of Mr. Ayres may well be considered together because both relate to the subject of the reduction of the cost of maintenance of the car as a whole. Mr. McAloney treats his topic by taking up parts of the equipment. His analysis of the percentage which the maintenance charges on each part of the equipment bear to the whole furnishes a direct index of the importance which each possess. Under Standard Accounts Nos. 6 and 8, wheels form the largest item and brake-shoes the next largest, while under Standard Account No. 7, the cost of renewal of magnet wire is about 3½ times as large as the next largest item, bearings and babbitt metal. Mr. McAloney offers significant suggestions as to the method of reducing the cost on each. The wear on wheels can be lessened very much by greater care in mating and less frequent use of the reverse in making emergency stops, while the life of magnet wire can be extended by the treatment of coils, although the greatest care is still required in inspection and handling.

The Present Status of the Work

Every convention has its most crowded day, and at the present convention this occurred yesterday. According to Mr. Gonzenbach, the "everybody busy" principle is the most efficient method of conducting business. Certainly everybody was busy yesterday. The American Association, all of the affiliated associations and the Manufacturers' Association held meetings and there were two sessions of the Engineering Association. To-day will be almost as busy with five sessions, because the Engineering Association is to hold the sessions originally scheduled for to-morrow, and the Accountants' Association will also consolidate in one session all of the work planned for two. Practically all of the delegates who were expected are now here and it is possible to say without fear of later developments that the convention has been in every way a success.

A good many people undoubtedly felt some misgivings about the attendance from the East because of the long distance to be travelled, and it is true that a number of familiar faces are missed. A great many of these cases, however, can be explained on account of important business engagements, and not because of the length of the journey. The conditions, in most of these instances, would probably have been the same if the convention had been held at Atlantic City. As yet we have heard no complaint from Eastern delegates of the time taken to come to Denver. It passed quickly, and the fact that most people travelled in special trains added much to the pleasure of the journey. Many new acquaintances were formed and many old ones renewed, and the duration of the trip was not noticed. On the other hand, the attendance from the Central and Far West and from the Southwest has been, of course, very much greater than ever before. Never before has there been so large an attendance at a national convention of railway men from Texas and the Pacific Coast. As already noted, the distance also had no material effect upon the exhibits; while perhaps not quite so numerous as last year, they are in every way very creditable both to the association and to the exhibitors, and three years ago would have been considered remarkable in extent and completeness.

For the first time in three years, the association has met in a city where there is a large street railway system, and this has certainly added very much to the pleasure of the meeting. This was the original plan of the association, and it was followed consistently until the 1903 convention at Saratoga. The advantages were great, and as a different city was selected practically every year, delegates had an opportunity of inspecting the practices of the railway companies in the city visited and derived valuable ideas. The return to the old plan has a most agreeable feature, as the convention partakes of the aspect of a personal visit upon friends. The officers of the Denver City Tramway Company have done everything they could to instill this idea and have been most hospitable, and the unique features of the property have made the visit a very instructive one to Eastern delegates.

It is too early, of course, to consider the location to be selected for future conventions, but we understand there is quite a movement to have the association meet again in

the Far West in 1911, possibly even on the Pacific slope. Such a plan is a daring one, but the suggestion is not so bold as it would have been thought to be a week ago. The convention this week has demonstrated conclusively something which was not previously believed, that a large body of street railway men are willing to go west of Kansas City to attend a convention.

Report on Freight and Express Traffic

The report of the committee on express and freight traffic presented before the Transportation & Traffic Association, is a most valuable compilation of financial results obtained by 39 companies from business of these classes. The data compiled by the committee relate to: (1) A statement of revenue that is divided as far as possible between passenger, mail, express, milk, freight and switching, together with the results per mile; (2) an analysis of expenses which, although not complete, is of remarkable interest; (3) various general information concerning principally relations with steam railroads and express companies and terminal arrangements.

While no names of companies are given, it is evident that information was obtained from properties of various sizes and the complexion of the committee is an indication that different sections of the country were reached in the collection of the data. A number of the companies listed have gross earnings of less than $100,000 per annum. The largest property reporting, which operates 617 miles of line, showed total gross revenue from operation of $2,400,158. The passenger revenue of this company was equal to 92 per cent of the total revenue from all sources and the remainder of the gross revenue was divided between the other earnings from operation as stated. The results of this company per mile of track with respect to passenger business and express and freight revenue are below those of a number of the other properties which furnished information. The smallest gross revenue is $38,249, of which $36,559 was derived from passenger travel, and the balance of 4 per cent represented the revenue from the classes of business described by this company as mail and freight. As this company operates only six miles of line, its passenger revenue per mile averaged $5,223.

Outside of the revenue given in the foregoing by the largest company reporting, classified in the report of the committee as comprising "total freight revenue," there is only one company which shows total gross for these classes of its business of more than $100,000. Thirty-seven of the companies, therefore, have less than $74,000 each of revenue from the freight business and 12 of the railways show total revenue from this source of below $6,200.

The miles of line operated by the companies contributing information show the extremes of 6 and 617, but only five of the roads have over 100 miles. One road did not report its mileage and 25 of the companies have less than 50 miles. This fact is significant as indicating that the small properties have been able to develop some measure of freight traffic even though they were able to give only short hauls on their lines and must have been limited in their arrangements for through routes or re-shipment over other roads, if, indeed, such arrangements existed at all.

By far the largest revenue per mile of line from mail, express and freight traffic is shown by a company with 8 miles of line, which secured 48.5 per cent of its total revenue from express, freight and switching.

The percentage of the total revenue received from the mail, express and freight business varies, for the 36 companies which furnish this figure, from 1.3 per cent to the unusual figure of 48.5 per cent, which is, of course, very far from the results of the average property. For all the companies, the average is 9.39 per cent and this is, we believe, a fair average figure for the present financial results obtained by the companies throughout the country that engage in the transportation of commodities as an addition to their passenger traffic.

The feature of the report of the committee which will be subject to the closest analysis is the table pertaining to the expenses charged against the express and freight traffic. A number of the companies do not furnish any of the figures requested by the committee. Where the expenses are charged, the car mileage basis of division appears to have been adopted generally. Several of the companies made their charges on account of various expenses on an arbitrary car-mileage basis and two of the properties charged against the revenue a total of 15 cents per car mile to cover maintenance of freight equipment and maintenance of track, roadway, etc. Only 8 lines report expenses for wagon delivery.

Following the suggestion made by President Allen in his annual address, it is to be hoped that no matter what other features of the work the incoming committee may take up, every effort will be made to compile data in relation to the financial results, with particular reference to the expense, so far as it may be determined with any reasonable approximation, of transacting the business.

Denver Conductors Well Posted

Members of the various associations who have had occation to use the cars of the Denver City Tramway Company to any great extent in travelling about the city have remarked upon the unusual amount of information which they can obtain from the conductors. Theoretically, conductors on a street railway system should be able to give correct information to all inquiries concerning the localities reached by the cars; but, practically, it is not possible for most companies, with the constant shifting of employees, to maintain a force of men competent and willing to keep themselves posted. It is more important to have the trainmen well informed in a city where there are a good many visitors constantly than in communities where the floating population is light, and this is evidently fully appreciated by the management in Denver. Mr. Beeler mentioned in his address of welcome before the Transportation & Traffic Association the interesting fact that the city system carries each day the equal of the entire population of the city or more, so it is evident that the tourist passenger provides a good share of the total traffic. Strangers in a city are more likely to ride if they can secure needed directions from employees.

The Weight of Cars

Mr. Ayres' thesis on the weights of cars is particularly appropriate in a report to be presented at Denver, because the Denver City Tramway Company was one of the earliest advocates of light cars and has consistently followed the plan in the construction of all of its rolling stock. Mr. Ayres has given a great deal of attention to this subject, as his several papers in the technical press and before engineering associations have testified, but in his association report he has treated the topic from a different standpoint than in his previous writings. In his paper yesterday he analyzed the effect of cars of different weights as they increased the demands for power, the wear of the track, the amount of the car repairs and the distribution system, and then reduced all of these matters to a basis of dollars and cents. Briefly, he found that each of these elements of cost can be represented by two terms, one of which varies with the weight of the car and the other independent of the weight. The sum of all of these terms, under average conditions, and assuming a car mileage of 150 per car per day, amounts to 7½ cents per pound of weight. Of course, with an average greater car mileage per day, or a cost of power higher than that assumed, of 1 cent per kw-hour, the cost per pound would be more. Mr. Ayres then suggested various methods by which the car body, trucks and equipment could be reduced in weight without a sacrifice of their strength.

Conventionalities

The ready smile of W. S. Sisson of Providence, R. I., fuses very nicely with his exhibit.

The Auditorium and Annex are open during the convention from 8 a. m. to 10 p. m.

It has been discovered that the "Rose Parlor" has been so named because the chairs are placed in rows.

Major J. M. Holloway of the American Steel & Wire Company says that this convention life is more strenuous than storming San Juan Hill.

T. H. Hogsett, counsel of the Lake Shore Electric Railway, is here with F. W. Coen, vice president and general manager of that company.

The official list, No. 2, of members and guests registered, that is, up to Tuesday night, makes a book of 128 pages and contains about 2550 names.

Can it be that Stedman and Grimes have a strain of Persian in them? Certainly both are poets and both uphold worthily the traditions of Omar.

Dwight Dean is in evidence and busy and his friends are glad to see him travelling eastward. Mr. Dean has been spending several weeks in California, and he looks the part.

Frank MacGovern of New York is on hand with his debonnaire imperturbability. In spite of his youthful appearance he is one of the oldest established as well as one of the best known men in the business.

John G. Barry, manager of the railway department of the General Electric Company, is one of the notable convention visitors. He is on his way home to Schenectady from an extensive trip to the Northwest and the Pacific Coast.

Among the Los Angeles men here is Alphonso A. Wigmore, who has charge of the Falk Company's business in that city. His work is referred to most enthusiastically by the other Falk representatives. After you, my dear Alphonse!

Today from 1 to 10 p. m. the general public will be admitted to the exhibition on payment of 25 cents a person. The proceeds will be given to Denver charities. A large throng is expected, for Denver people are greatly interested in the convention.

Harry Munroe of Chicago grumbles because, as he says, he has to "stand watch" about all the time at the "G. E." exhibit. Of course if Harry wasn't a natural born kicker he would realize that it is because he is so popular that he is in constant demand.

George Keegan, the able secretary-treasurer of the Manufacturers' Association, is all smiles. Early on Wednesday morning he received a telegram from New York announcing the safe arrival of a baby daughter in his family. Needless to say Mr. Keegan is not going to tarry in Denver after the convention is over.

The Gilpin & Clear Creek District Railway is now building to connect Pactolus on the "Moffat Road" with Russell Gulch, Colo. It will be 22 miles long and will be operated through a mining district by steam locomotives first, but may be electrified later. Robert A. Hall of Denver, general manager of the road, is a convention visitor.

George Weston, a member of the Board of Supervising Engineers, Chicago Traction, is in Denver attending the convention, glad to escape for a few days from the exacting duties of his position and the perplexities incident to a responsible public post. E. N. Lake, division engineer for the Board of Supervising Engineers, is also at the convention.

Ernest Gonzenbach, "the man who made Sheboygan famous," is one of the busiest of convention visitors. A telegram from Sheboygan conveys the interesting rumor that Mr. Gonzenbach is accused of writing "The Confessions of a Reformed Street Railway President" in last week's issue of the Saturday Evening Post. Mr. Gonzenbach is vice president, treasurer and general manager of the Sheboygan (Wis.) Light, Power & Railway Company. He is accompanied by Mrs. Gonzenbach, and the two will spend about a week, after the convention, in the irrigated section of Colorado.

M. C. Brush, general manager of the Buffalo & Lake Erie Traction Company, made up a pool on the time the New York Central-Rock Island train would arrive in Denver. There was great interest in the event and when the train arrived in Denver at 6:34 p. m., Bertram Berry and J. V. Smith, who both guessed 6:35, were declared joint winners.

One of the finest "individual" exhibits is made by the Hildreth Varnish Company. The representative of this company is the one best exhibit of the outfit. Architecturally he is a thing of beauty and a joy forever; personally he is a good fellow. Known to nearly every man in the business, a convention would hardly be complete without Charles C. Castle.

So far as known, the only past-president of the parent association present is John M. Roach of the Chicago Railways Company. Mr. Roach comes from the worries of a controversy relating to a wage adjustment, in which a great street railway strike in Chicago was narrowly averted, and he welcomes the opportunity of spending a few days with his old associates at the Denver convention.

It was H. C. Glaze, railway representative of the "G. E." office in Denver, who, as pitcher, was so largely instrumental in carrying the West to victory in the famous ball game of the East vs. the West at the National Electric Light convention in Atlantic City last June. Mr. Glaze is also to be complimented on the success of the "G. E." exhibit at Denver, for he took the brunt of the work of preparation.

All Denver round-trip tickets must be validated at the Union Depot or at the City Ticket Office of the line over which return trip is made from Denver, **otherwise they will not be accepted for return passage.** Tickets may be validated in advance of the returning date, but the returning date must be specified. No fee is charged for validation. All Pacific Coast tickets must be validated at the joint ticket agency in the Coast city from which the return trip is begun.

The attractive exhibit of the American Brake Shoe & Foundry Company, showing as it does on a sample board a large variety of brake shoes, all centering in the standard of the Engineering Association, is a reminder that F. W. Sargent, chief engineer of the company, is not present. Mr. Sargent expected to come until the last moment but very important matters in the East required his attention. This is the first convention in a number of years which Mr. Sargent has missed.

Oklahoma City is represented by Anton H. Classen, president, and J. J. Johnson, secretary, of the Oklahoma Railway Company. Mrs. Classen accompanies her husband. The Oklahoma system is extending so rapidly that the company is in almost constant need of new material; nevertheless two trucks of different types intended for this company were diverted from their proper destination in Oklahoma City and are on exhibition in the exhibit of the Standard Motor Truck Company.

The entertainment committee has provided a theater party for this evening. Mrs. Leslie Carter in "Vasta Herne" at the Broadway Theater, opposite the Brown Palace Hotel, will be the attraction. The committee has secured the entire house and admission will be by official badge only. Ross F. Hayes of the Curtain Supply Company is in immediate charge of arrangements at the theater. The curtain will go up at 8:30 p. m. After the performance there will be informal dancing in the ball room of the Brown Palace Hotel for an hour.

Ralph W. Pope, secretary of the American Institute of Electrical Engineers, who is attending the convention, is greatly interested in the question of the conservation of natural resources. He attended the conference of governors held at Washington in May, 1908, at the call of President Roosevelt, and he was also an official delegate to the first National Conservation Congress held in Seattle in August of this year. Yesterday there was a meeting of the Colorado Conservation Commission at the State Capitol, and Mr. Pope was present. The Institute secretary finds that in Pope was present.

Ralph Sanger is a newcomer, this being the first convention he has attended. He seems as much at home, however, as he used to be in his former business. Before entering the firm of Wonham, Magor & Sanger he was connected with prominent banking interests in New York. With Mr. Sanger as the leader, supported by H. A. Goode, the cosmopolitan Britisher, R. V. Collins of the American Automatic Switch Company, and the bustling Mr. Willis, the interests of the "H. B." life guard are well taken care of.

Frank W. Frueauff is both president of the National Electric Light Association and first vice president and general manager of the Denver Gas & Electric Company, which is one of the most enterprising public service companies in the country. He shares with Henry L. Doherty the honor of making Denver the City of Lights. Mr. Frueauff is a very welcome convention visitor. He has been tested on the moralometer at the Wagner booth, and the reading was "Star-connected." As Mr. Frueauff's engagement to Miss Antoinette Perry, a charming actress, is announced, the wonderful accuracy of the instrument excited wide and favorable comment.

The entertainment committee of the Manufacturers' Association has appointed the customary ladies' committee to act during the Denver convention. This committee consists of Mrs. William G. Evans, wife of the president of the Denver City Tramway Company, chairman, and Mrs. James Brown, Mrs. Samuel Perry, Mrs. Archbold, Mrs. Brown, Mrs. Fred Moffat, Mrs. Gerald Hughes, Mrs. Rodney Curtis, Mrs. George Saugon, Mrs. John Evans, Mrs. C. Loomis Allen, Mrs. Rockwell, Mrs. Stevens, Mrs. Kimball, Mrs. Linn, Mrs. Lincoln, Mrs. Apperson, Mrs. Purvis, Mrs. Kilpatrick, Mrs. H. C. Evans, Mrs. Will McLain, Mrs. E. B. Entwistle, Mrs. J. L. Replogle, Mrs. Charles C. Peirce, Mrs. McCloy, Mrs. Victor Angerer, Mrs. Charles S. Clark, Mrs. F. J. Drake and Mrs. Boyer.

For the benefit of those who desire to visit the Pacific Coast and who have not made arrangements for such a trip before leaving their home cities, provisions have been made for special excursion round-trip tickets from Denver to Pacific Coast points with Oct. 8 and 9 as selling dates and October 31 as the return limit. The round-trip fare from Denver to Portland, Seattle and Vancouver, or to San Francisco, Los Angeles and San Diego, is $45. The round-trip fare from Denver to Seattle, returning via San Francisco and Los Angeles, or vice versa, is $60. It should be remembered, however, that persons making these trips from Denver should return to that city in time to enable them to reach their home cities on Oct. 31, which is the expiring date of the round-trip tickets to Denver.

The Accountants' Association holds the record for attendance of past presidents. There are present H. L. Wilson of Boston, president 1897-1898; William F. Ham of Washington, president 1900-1901; F. E. Smith of Chicago, president 1903-1904, and W. G. Ross, Montreal, president 1904-1905. W. B. Brockway, Yonkers, president 1905-1906, may arrive this afternoon on his way to San Francisco, where he is going this week, but could not come before as he was detained by an important meeting in New York Tuesday morning. H. R. Goshorn of Philadelphia, president of the Claim Agents' Association in 1907-1908, is the only past president of that association in attendance. There have been no past presidents of the Engineering Association present in Denver at this convention.

CONVENTION PROGRAM FOR TODAY

American Association.

(AUDITORIUM HALL)

2 P. M. to 5 P. M. (Executive Session.)

Reports of Committees.

(a) Education (continued.)

(b) Compensation for Carrying United States Mail (continued).

(c) Insurance.

(d) Public Relations.

(e) Subjects for Confidential Bulletins in 1910.

(f) McGraw Dictionary.

(g) Brill Prize.

Report of Committee on Nominations.

Election of Officers.

Resolutions.

Unfinished Business.

Adjournment.

Accountants' Association.

(SAVOY HOTEL.)

9:30 A. M. to 12:30 P. M.

Report of the Committee on Standard Classification of Accounts and Form of Report (continued).

Paper—"The Electric Railway Auditor, His Duties and Relation to the Organization," by W. B. Brockway, Chief Accountant, Ford, Bacon & Davis, New York, N. Y.

Paper—"Payrolls and Timekeeping," by N. E. Stubbs, Auditor, United Railways & Electric Company of Baltimore, Baltimore, Md.

Paper—"Stores Accounting and Inventory," by E. S. Pattee, Secretary and Comptroller, Twin City Rapid Transit Company, Minneapolis, Minn.

Report of Joint Committee on Shop Accounting.

Reports of Convention Committees.

Report of Nominating Committee.

Election of Officers.

Installation of Officers.

Adjournment.

Engineering Association.

(ROSE PARLOR)

9:30 A. M. to 12:30 P. M.

Report of Committee on Standards.

Report of Committee on Power Distribution.

2 P. M. to 5 P. M.

Report of Joint Committee on Shop Accounting.

Question Box.

General Business.

Report of Nominating Committee.

Election of Officers.

Installation of Officers.

Adjournment.

Transportation and Traffic Association.

(AUDITORIUM HALL.)

9:30 A. M. to 12:30 P. M.

Report of Committee on City Rules (continued).

Report of Committee on Transfers and Transfer Information.

Paper—"Chicago's Transfer Crusade," by Joseph V. Sullivan, General Supervisor, Chicago Railways Company, Chicago, Ill.

Unfinished Business.

Report of Committee on Training of Transportation Employees.

General Business.

Report of Nominating Committee.

Election of Officers.

Installation of Officers.

Adjournment.

WEDNESDAY MEETING OF AMERICAN ASSOCIATION

The American Association held its second meeting yesterday afternoon in the Auditorium Hall. The meeting was called to order by President Shaw at about 2:30 p. m. and the session lasted until 5:30 p. m. The first order of business was the appointment of a nominating committee to nominate officers for the ensuing year. President Shaw appointed the following committee:

E. C. Foster, of New Orleans, chairman; R. T. Laffin, Boston, H. A. Nicholl, Anderson, Ind., W. G. Ross, Montreal, John A. Beeler, Denver.

The session was occupied entirely by a discussion of the two subjects scheduled for the day—the report of the committee on Interstate Commerce Commission affairs and the report of the committee on compensation for carrying United States mail. The discussion on the latter subject was not concluded yesterday and will be carried over until tomorrow, which is the last session of the association.

NOTICE TO THE MEMBERS OF THE BOSTON PARTY

Charles S. Clark, secretary of the Massachusetts Street Railway Association, who has charge of the Massachusetts special train, has announced that on returning from the Moffat-Road" trip, dinner will be served in the dining car "Continental," for the Massachusetts party, immediately upon arrival of the train. Inasmuch as this is not included in the amount collected for the trip, a charge of $1 per passenger will be made.

It is desirable that baggage be in the Boston & Maine baggage car of the Massachusetts special train not later than 10 p. m. of Friday, Oct. 8. Arrangements have been made with the transfer company to send a special wagon at 10 a. m. and 7 p. m. to all hotels at which it is understood that members of the party are located. Members are requested to have baggage properly labeled and ready for one of these trips, and arrange to prepay transfer charge.

IMPORTANT NOTICE TO EXHIBITORS

The executive committee passed a resolution that all exhibits can be packed at 12 M. on Friday and that no dismantling of booths, etc., shall be done before that time. The return shipment of goods has been arranged for through the Weicker Transfer Company. Mr. Lorimer of that company has an office in the southeast corner of the Auditorium. Proper certificates for the return of shipments free can be secured from him. Exhibitors who desire to have their goods packed may arrange with this concern at the rate of 50 cents an hour. Exhibitors who desire to do their own packing, but would like to have the Weicker Transfer Company arrange for the billing, can do so at a fee of 50 cents.

LUNCHEON OF ACCOUNTANTS' ASSOCIATION

Members of the Accountants' Association held their annual "Get-together" luncheon at the Hotel Savoy at 1 o'clock on Wednesday. Following the usual custom President Robert N. Wallis called on various members for short, informal talks and responses were made by William A. Doty, auditor Denver City Tramway Company; O. S. Moore, treasurer and auditor Tucson (Ariz.) Rapid Transit Company; H. S. Norton, auditor Omaha, Lincoln & Beatrice Railway; Will Browne, auditor Utah Light & Railway Company; W. G. Ross, managing director Montreal Street Railway; F. E. Smith, comptroller Chicago Railways Company; H. S. Swift, secretary and auditor Toledo Railways & Light Company; W. H. Forse, Jr., treasurer Indiana Union Traction Company; F. W. Sweney, special examiner Interstate Commerce Commission; and H. E. Weeks, secretary and treasurer Tri-City Railway. President Wallis, in his remarks, thanked the members of the executive committee for their cordial support during the year.

LADIES' AFTERNOON AT THE COUNTRY CLUB

Largely by the good offices of Mrs. William G. Evans, wife of the president of the Denver City Tramway Company, it has been arranged that the Denver Country Club, one of the most exclusive social organizations in the city, shall give a "ladies' afternoon" at the club this (Thursday) afternoon in honor of the ladies of the convention. There will be a reception, music, an afternoon tea, a clock-golf contest and 10 tables of bridge. Special automobiles holding 20 persons will leave the Broadway entrance of the Brown Palace Hotel at 2 p. m. to take the ladies to the club. Ladies should wear their badges without fail. Appropriate prizes will be given to the winners at clock-golf and at bridge. C. R. Ellicott (Westinghouse Traction Brake Company) and N. M. Garland (Ohio Brass Company) will represent the entertainment committee of the Manufacturers' Association at this function.

DENVER TO NEW YORK SPECIAL TRAIN

The train committee who had charge of the Pennsylvania-New York-to-Denver special has arranged with the Santa Fe to run a special train from Denver to New York, which will leave Denver Friday at 11:30 p. m., stopping all day on Saturday at Colorado Springs, leaving there at 10:30 p. m. and running through Kansas City, St. Louis and Pittsburg, arriving in New York Tuesday at 7:40 a. m. The Pullman Company is holding the necessary equipment, but it is necessary to let the Santa Fe know just how many passengers will be on the train. Those holding tickets good returning via the Santa Fe and Chicago & Alton should notify J. P. Hall, general agent, Atchison, Topeka & Santa Fe, 901 Seventeenth Street, telephone Main 280, at once and reserve Pullman accommodations on this train.

LAST CALL FOR MOFFAT EXCURSION

All those who expect to go on the official excursion over the Moffat Road tomorrow are again reminded that it will be necessary to secure tickets from the entertainment committee by noon today, in order that there may be ample provision of train accommodations and food for the hungry. As it expected that there will be several trains, carrying about 2000 people, the reason for this arrangement is obvious. Tickets, including lunch, are sold at $3 for the round trip. The regular rate (without lunch, of course) is $5. Special trains will leave the Moffat Station, Fifteenth and Bassett Streets, at 8:30 a. m. sharp on Friday, going to Corona, amid the perpetual snows, and returning between five and six in the evening.

The guessing contest of the Allis-Chalmers Company on the number of turbine blades for a 1000-kw turbine, shown in a glass case at the company's exhibit, will close at 4 p. m. today. Any conventioneer may guess as many times as he chooses. Valuable prizes will be given to the successful contestants.

The Pacific Coast supply men are arranging to give a dinner to railway men in their territory at the Albany at 8 p. m. tonight (Thursday). About 50 invitations have been issued. S. I. Wailes of the National Brake & Electric Company is a "live wire" in the affair.

The first beet sugar factory in Colorado was erected at Grand Junction in 1899. There are now 16 factories in the state which produced $80,000,000 of beet sugar between 1899 and 1908.

WEDNESDAY MEETINGS OF THE ENGINEERING ASSOCIATION

President Winsor called the morning meeting to order and announced the report of the committee on equipment. The discussion was opened by W. H. McAloney, superintendent of shops, Denver City Tramway. Messrs. L. L. Smith and J. S. Doyle, other members of the committee, were not able to attend the convention.

Mr. McAloney referred to page 5 of the report. Owing to the methods of handling material and stores used in Denver he had not been able to give proportions representing the practical material accounts. The disbursements were divided into about 37 practical accounts. The list was applicable to any system as shown by the percentages and the same ratios or percentages would hold good throughout the country, except as local conditions might vary them. When questioned regarding the material charges for wheels Mr. McAloney said that only eight cars of his road had rolled steel wheels. Cast iron wheels were used, and the charge for wheels made up 15 per cent of the total of all disbursements for material for the entire maintenance of cars, trucks, bodies and electrical equipment. Brake shoes, brake appliances, magnet wire and wheels amounted to practically 50 per cent of all the maintenance material disbursements. The maximum speed of the cars on 500 volts was 22 miles on level track. The average schedule speed on the system was about 9.5 miles and included layovers.

President Winsor read a communication from John Lindall, superintendent of rolling stock and shops, Boston Elevated Railway, addressed to Mr. Smith, chairman of the committee on equipment.

Letter from Mr. Lindall

I do not agree with the committee's suggestion with reference to trolley wheels, that it is economical to increase the life by using large diameter wheels on suburban lines and later transferring them to city lines. From experience on our lines, I am of the opinion that in order to maintain perfect contact between trolley wheel and wire, it is very desirable to make the wheel and outer end of the pole as light as possible and on some of our heaviest and fastest equipment, we have been able to obtain better service from a 4-in. wheel than we have from larger wheels of the same composition. It may not be out of place to call attention at this time to the desirability of having a certain amount of spring in the trolley pole where this can be obtained without interference with the trolley wire at low points, as a pole with considerable spring will absorb shocks and more readily respond to inequalities, both vertical and horizontal, in the wire.

Educational work and a better knowledge by the men "behind the guns" are of the greatest importance. We are just starting weekly meetings of shop and car house employees in an endeavor to more thoroughly ground the men in mechanical and electrical principles, give them a better understanding of the apparatus, and add interest to their work. The subjects will be handled by our engineers, superintendents and foremen, and while the meetings may not be as scholastically handled as by an experienced instructor, it is expected that the connection between the lesson and every-day work will be more direct.

The report on Car Weights as Affecting Operating Costs is of great importance to the railway companies. Undoubtedly, much of the present unnecessary weight in cars is due to lack of proper appreciation of the cost of carrying weights and to patch-work methods of overcoming failures. Where failures occur, it is the usual practice to increase the strength at that point, by increasing the weight without giving consideration to the removal of the cause of failure, or obtaining more suitable material for the purpose. However, in reducing weights of cars we should be very careful to see that the pendulum does not swing too far in the opposite direction and result in failures of equipment.

The work of the committee during the present year as well as in previous years has been of great value in advancing the state of the art of carbon brush manufacture and improving the conditions of motor commutation. Most assuredly a grooved commutator and high grade brush, with low brush tension, is the proper thing. This combination will reduce commutator wear to a minimum, but under these conditions a treated brush is entirely unsatisfactory, for the reason that the dust given off by the wear of the brush will adhere and accumulate in the slot and cause short circuiting of the bars. The brush also becomes gummy and causes friction and sticking in the brush holders. Under these conditions, a low tension is not sufficient to keep the brushes on the commutator. Several high-grade brushes have now reached the point where the wear on the commutator is so slight as to indicate a life of several years. As a matter of fact, the brushes are scrapped long before they are worn out on account of brush holder wear. This points to the necessity of a closer fit in the brush holders, maximum bearing surface, and a brush spring with which the pressure is applied to the brush in a direction radial to the commutator at all times.

The under-cutting device, as shown in the committee's report, is extremely simple, and the time given for doing the work with it is very short, but too much emphasis cannot be laid upon the importance of doing this work thoroughly, as it has been found by experience that poor undercutting is worse than no under-cutting.

Solid steel wheels appeal to me, but the proposed standard sizes could not be used on the Boston Elevated Railway with present trucks and present track standards.

F. H. Lincoln, Philadelphia Rapid Transit Company, said that meetings of foremen and inspectors and men that had to do with the handling of the equipment had been held weekly or bi-weekly for four years. Men were also given certain lines of work. One of these lines was to watch the pressure of the brushes on the commutator. After investigating brush pressure very carefully it had been found that the men in the barns put in springs that gave brush pressures of anywhere from 7 to 20 pounds, which resulted in excessive commutator wear. By taking up such subjects with the men employed in the car houses it had been possible to overcome that difficulty and to decrease a large amount of the work which before had been necessary in the way of turning down and renewing commutators.

William Roberts, superintendent motive power, Northern Ohio Traction & Light Company, Akron, Ohio, was making a comparative test on two sections of his road, each with about an equal number of cars. On one section the commutators were slotted and on the other they were not. He thought that if the commutators on the motors were to be grooved, then those at the power house on the rotary converters and generators also should be grooved.

Mr. McAloney pointed out that by getting as large a diameter originally as possible there would be a longer time for wear before the point of trouble was reached. Some men held that a diameter of 8 in. or 8½ in. should be the limit. He wished to emphasize the thought that in many shops commutators perhaps were allowed to get too small, and the little economy apparently had in the lengthened life of the commutator gave increased trouble.

Mr. Roberts thought that more attention should be directed to the use of a better class of mica and better copper and to care about the pressure of the springs on the brushes on the periphery of the commutator. These would eliminate the greater part of the troubles.

Mr. McAloney was decided in his views that between the sloting of commutators and the using of high-grade brushes he had done away with much commutator trouble. Whether it was due to the one or to the other he did not know, but thought the combination, with the regulation of brush-holder tension, had brought the good results.

William J. Harvie, chief engineer, Oneida Railway Company, suggested three things which were of the utmost importance. One was the spacing of brush-holders, the second was the tension of brushes and the third was the slotting of the commutator. None was of greater importance than the question of quality of brush to be used. The difference in tension and in spacing which actually occurred was surprising. This suggested the matter of non-adjustable parts; he thought that a motor so constructed that adjustments must be made in the shop, at least in the case of the smaller roads, or by specific arrangement in the case

of the large road, was the most suitable. By the use of a special tool-post, used in a Shafer tool-post, which carried the tool quite a distance forward, it was possible to do quick and accurate work in slotting. His records showed that a commutator of 109 bars had been slotted in 8.5 min.

W. H. Evans, Buffalo, thought that those who operated cars equally in both directions would find that they had more trouble with commutators than those who operated cars in one direction only. He had found, with the 75-hp motor, that just the slotting of the commutator had reduced the trouble very materially without practically any other change having been made.

What Mr. Harvie had said with regard to the adjustments of the springs and brush-holders was very important, but it did not detract from the real advantage of slotting the commutator and he favored slotting all commutators. In regard to the diameter of the commutators, he thought the advantage would be in favor of the larger diameter rather than the smaller one. It would seem, in some cases, that the designers had rather skimped the amount of material used on the commutators to a disadvantageous point.

M. V. Ayres, electrical engineer, Boston & Worcester Street Railway, said that he operated 11 rotary converters that illustrate very well the way in which the different points of view arise in regard to the slotting question. Two machines of 250 kw capacity, three-phase, ran 10 hours a day for two years after they were originally installed, without need for changing a brush. The commutators were not sandpapered. They were not slotted, and he thought that as long as they ran well they would not be slotted. He also operated three 500-kw six-phase rotaries that ran fairly well at first, but afterward developed vicious sparking, and would not run more than a week without severe grinding. He found that these machines after having been turned down and put in good condition would get into bad condition again in three weeks. These machines were subsequently slotted, and the trouble was cured.

A. T. Clark, acting superintendent of shops, United Railways & Electric Company, Baltimore, had found that a most important thing was to clean out the commutators after they had been grooved, otherwise the mica would cause trouble. His men spent more time in cleaning after grooving than in grooving. A hood was put over the commutator and an open space left through which the operator could work. A small fan drew off the accumulation of mica-dirt. He heartily endorsed grooving, which had cut down troubles 75 per cent on certain types of motors.

Mr. Evans had used an air-jet for playing on the groove all the time. This served the purpose of keeping the dust out of the operator's face as well as for cleaning the slots.

A. D. Campbell, master mechanic, Seattle Electric Company, slotted all commutators, using a saw 1 in. in diameter, and running it at about 2000 r.p.m. Setting the armature in place, and slotting a 111-bar commutator, took 4 minutes and 20 seconds. It took 15 minutes to take the armature off the floor, slot it, make the transformer test, and lay it down.

S. M. Coffin, master mechanic, Mobile Light & Railroad Company, did not slot commutators. He thought that the alignment of the brush-holders, and the fitting of the brush, was important. He closely watched the brush holder at the fitting, so that in cars which ran both ways it did not play back and forth.

Mr. Harvie had tried slotting 1/16-in. deep and had found little improvement, but by slotting 1/32-in. the overhauling period had been extended to 50,000 miles.

W. G. Denny, master mechanic, Puget Sound Electric Railway, had six or seven different kinds of armatures and slotted all of the commutators except the GE 57. The work was done on a lathe and took about 15 or 20 minutes. A little steel point was raked through the slot each time, and the results were good.

President Winsor said that the Boston Elevated Railway Company had found great improvement from slotting WP 50 commutators. The life of the commutator was increased six times, but other commutators could not be grooved without causing flashing.

Perhaps only the larger companies could study the question of resistances, as they had done, with a recording ammeter, but the improvements made by resetting the resistance had been astonishing. He thought that some might lay troubles to the slotting, or lack of slotting, when they were due to something else, and on the other hand some condemned the slotting while the trouble was caused by something else.

Regarding trolley wheels, his company used a very light trolley harp and a very light wheel, and the total cost of wheels, harps, poles, trolley bases, etc., was $2100 a year for over 40,000,000 car miles.

R. C. Taylor, superintendent of motive power, Indiana Union Traction Company, had gone into the matter in the last year or so. The men had been able to do very good work with a motor-driven device which carried two saws. They cut two grooves at one time, and have reduced the time even to the limits given by Mr. Campbell. The slotting has reduced commutator troubles very materially.

Mr. Taylor was interested in Mr. Winsor's remarks about trolley poles and wheels. His were high-speed interurban cars and he used 6-in. wheels. He had found that they could get the best result with a 10-ft. pole, which was shorter than usual, and the pressure most satisfactory for the conditions on his road was 35 lb. Unless the pressures were very carefully adjusted, trolley wheel trouble occurred. His method of adjusting the springs was to hang a 55-lb. weight on the end of the pole and screw the base up until the wheel touched the wire.

L. W. Jacques, Fort Wayne & Wabash Valley Traction Company, used a 11 ft. 6 in. pole on interurban cars only. The life of trolley wheels during the last year was a little over 7000 miles. The same trolley wheels were used on the city as on interurban cars, and after they had served 3000 or 4000 miles on the interurban their service was finished on the city cars.

Mr. Taylor said that the Indiana Union Traction Company ran steel tires on interurban cars until they were 12⅜ in. thick and then took them off the interurban and put them on the city cars, and in that way the tire was used completely. The company had a contract for brake shoes on a mileage basis last year and was able in that way to get a very good price. The manufacturers were not willing to renew that agreement this year and the company was now obliged to buy shoes on a tonnage basis.

Mr. Evans thought that the purchase of brake shoes on the mileage basis was going to be the ultimate method where the best quality of material as well as the best results were required.

Mr. Ayres then presented in abstract his paper on "Car Weights as Affecting Operating Costs," which will be found elsewhere.

Mr. Schreiber said that about a year ago the question came up on his road whether or not it was better to operate a certain line with five 20-ton cars or with four 40-ton cars. It was intended at first to take one car off and increase the speed. A profile was made of the entire route and the cars were ridden to get the average number of stops and other data of performance. The current curves were then constructed from this data. It was found, after the power consumption and other savings were figured out, that three or four bridges on the line had to be strengthened in order to carry the heavier cars. The weight of cars was often increased without considering the bridges or the right of way in any manner. It was difficult to tell just what the extra repairs to the track would be or the extra maintenance, but some general idea of it could be gained. The conclusion

reached after making the studies referred to was that it was not economical to operate 40-ton cars in place of the 20-ton cars, even if one car could be taken off. The results obtained approached those given by Mr. Ayres very closely.

The total operating cost per car-mile for the 20-ton cars, as given by Mr. Ayres, was 7.55 cents. The speaker's conclusion was that it cost about 50 per cent more for the 40-ton cars. He knew at least a few roads which were using four-motor equipment where better operating results could be obtained by using two-motor equipment. The increased size of cars caused by the use of the pay-as-you-enter system introduced a new difficulty, that of clearances on account of the long platform. In most cities proper clearances had not been provided for such cars. Of course, cars could pass on double-track curves by waiting, but that would affect the speed schedule. He thought the mechanical men should co-operate with the way engineers to see what effect the increase in size of cars would have on the clearances.

F. H. Lincoln, Philadelphia Rapid Transit Company, said there was another question that should be considered by the engineering department, and that was the education of the men operating the cars, to regulate the consumption of current on portions of the road where it was not necessary to use current. A few months ago Mr. Twining, chief engineer of the company, took that question up on elevated lines in Philadelphia. After going over the grades and station stops, the portions of the road were marked where the motormen could use current in series parallel position of the controller. The current consumption was cut down wonderfully.

William Roberts, master mechanic Northern Ohio Traction & Light Company, quoted some interesting data on current consumption of interurban cars which had been weighed on standard scales. Three men were selected and put on their metal to make a good showing. One man operated over a division on 219 kw.-hours, another on 187 kw.-hours and the third on 160 kw.-hours. The returns of these tests were given in tables which will be embodied in the final printing of the report.

President Winsor asked Mr. McAloney if he had any extra maintenance, due to the light weight of the cars used in Denver; that is, were cars strong enough to carry the passengers and do the work?

Mr. McAloney said he believed that the light weight limit had not been exceeded. In one type of car of which 38 were in operation he felt as if the limit had been reached on the body. They could be improved by strengthening some parts of the body, for instance, the platform, by better application of angles. They had by no means been found to be too weak in construction, however. This particular type of car was 38 ft. 1 in. over all and had a seating capacity of 46. Several years ago Mr. Beeler, general manager of the Denver City Tramway, insisted that the weight question be studied closely to cut it down until the limit was reached. Many cars had a great deal of cast iron used in their construction which could be entirely eliminated, even down to the brake shoes. There was no casting on a car which could not be made of malleable iron or cast steel with less weight.

Mr. Evans pointed out that the tendency in recent years has been towards building cars considerably heavier than the requirements of the service demanded. There had also been a tendency to use extra appliances which were entirely superfluous. There was a notable example of the reverse of this in the Denver cars, which had, in a way, more appliances than usual, including even an appliance for carrying a bicycle on the rear of a car. In going over some cars recently designed, he found that by simply removing parts that were unnecessary if the car would be operated always from one end, 2334 lb. could be saved. The Denver cars with side entrances made it possible to reduce the platform weight very materially at both ends.

E. W. Holst, Boston & Northern Street Railway, said that he had gone into the question of reducing weights very carefully. He had succeeded in cutting down the car body to 14,000 lb. Trucks weighing 14,200 lb. were cut down to 12,000 lb. The electrical equipment, weighing 14,250 lb., was the hardest to reduce in weight. The General Electric Company went over the design very carefully with him and succeeded in cutting out 250 lb. by changes in the gear case and the use of pressed steel on the boxes underneath instead of cast iron, as previously used.

W. P. Barba, Midvale Steel Company, Philadelphia, said the question of rolled steel wheels was one in which his company was deeply interested. He had recently received requests for information as to whether or not a very light wheel for city service could be produced to advantage to the consumer.

Mr. Ayres pointed out that the weight in the rim of the wheel was the worst place in the whole car, because the energy required for acceleration was greatest there. The weight in the rim had to be accelerated up to a much higher speed than the weight in any other part of the trucks.

Mr. Ayres, in closing the discussion on his paper, said that he believed on the whole that his estimates offered a good basis for getting at the facts. He had not taken up the question of grades, as of course, power consumption varied enormously with the grades, and undoubtedly also car repairs. He called attention particularly to the McKean motor car on exhibition at the convention as an example of a wonderfully light car for its size, and he thought many of the principles used in it could be used as well in an electric car. He also believed that while a good deal could be done in reducing car weights without making very radical changes in design, more could be done by making radical changes in design, and that it was worth while to do it. He was going away from Denver a convert to the side entrance and the single end operation. The pay-as-you-enter car was necessarily very heavy, and in his opinion it was a bad car from an engineering point of view.

Carbon Brushes

L. W. Jacques, Fort Wayne & Wabash Valley, presented this section of the report. He said that the improvement in the quality of carbon brushes made by the manufacturers within the last two years was very noticeable. The tests recommended last year by the committee had been carried out by most of the manufacturers, who were using the recommended tests before furnishing brushes to the railway companies. The report this year showed that 23 companies had gone from the low-grade to the high-grade brush within the last year, with satisfactory results and reduced expenses. The manufacturers all stated that the grooving of commutators required a softer brush. Most of the manufacturers stated that the tests as recommended last year were practical for all purposes.

Mr. Evans thought the committee was entitled to much credit on account of the improvement which had recently been made in the quality of brushes.

Steel Tired Versus Rolled Steel Wheels

Mr. McAloney moved that the recommendations at the end of the report on the adoption of standard dimensions for rolled steel wheels be referred to the committee on standards for prompt consideration.

Mr. Taylor inquired if the gage line of the hub of the wheel, as shown in the report, conformed to the standard axle as adopted by the association, and also whether the thickness of the hub should not be specified in making a recommendation. Many companies made it a practice to key-seat the wheels while others did not. He thought that the thickness of the hub should be specified.

Mr. Jacques replied that the proposed standard wheels were in accord with the other standards of the association.

E. W. Holst, Boston & Northern Street Railway, asked what the general practice was in the case of a 33-in. steel wheel, after it is worn down to less than 31 in. in diameter.

Mr. Lincoln replied that in Philadelphia new wheels were 33 in. in diameter. They were of a type which made it possible to wear the wheels down to about 27½ in. in diameter before scrapping them. A number of the older types of motors, such as Westinghouse No. 3, were in use so that the wheels could be worn down to a small diameter.

Mr. Roberts said he was using a 33-in. steel wheel, and a 34½-in. cast-iron wheel, with a 3-in. tread on the steel wheel and a 2¾-in. tread on the cast-iron wheel. These conformed so closely to one of the recommended sizes that he would be able to use that size wheel very easily. While he preferred to adopt a larger wheel, in order to increase the speed somewhat on limited cars, he preferred to increase the gear ratio and keep the cars as nearly as possible to the present height.

Mr. Barba said there was a limitation to the outside diameter of the hub that could be made by standard dies and standard rolls for each given type of wheel. At the present time, for a 5½-in. axle a hub as small as 8 in. was used.

The motion of Mr. McAloney that the recommendation of the committee that the rolled wheels as described in the report be made the standard size, and that this matter be referred to the committee on standards for prompt action, was unanimously carried.

Proposed Flange Contour

Mr. Schreiber did not see any reasons for making any change in the standards in this respect.

Mr. Taylor pointed out that at the time the present standard flange contour was adopted the members of the committee went into the question of flange contour very thoroughly The reason for the adoption of the shape of the present standard flange was the fact that from an examination of many wheels which had long been in service, the wheels were worn to the shape adopted. If a new standard was adopted it would only be a question of time when the back of the flange would be worn off in service, not only wearing the wheel, but the special work also.

Mr. Schreiber moved that the recommendation for changing the flange contour from the adopted standard be stricken out of the report.

Mr. Evans, on behalf of the committee, said that the proposed contour was an exact reproduction of the shape of the M. C. B. standard flange, but he did not see any good reason for making a change.

Mr. Sehreiber's motion was unanimously carried.

Gage for Mounting Wheels

W. J. Harvie, Utica & Mohawk Valley Railway, said that the gage shown in the report would not be suitable, without modifications, for mounting anything but steel wheels. The backs of the steel wheels were turned to a very regular surface to apply the gage on, whereas on a chilled wheel the back of the flange was of a different shape and required a different projection on the gage.

Mr. Jacques said he knew of two companies that were using a similar gage, and if the wheel flange of both wheels was standard he did not see why it could not be used.

Mr. Evans' criticism of the design of gage presented was that the back of the flange should not be taken into consideration at all. The throat of flanges should be the gaging points and the back should be taken care of by a separate arrangement in this same gage. He did not think it would be possible to press wheels on with this gage for the reason that the gage fitted the flanges neatly.

A motion to refer the recommendation covering gage for mounting wheels back to the committee, was adopted.

Mr. Evans then offered the following resolution:

"Resolved, That the engineering association take up and investigate the question of the desirable system for the government and instruction of regular apprentices in the mechanical trades in connection with the maintenance of the equipment of electric railways. A regular apprentice, it is understood, is one who has had no previous shop experience and is not a graduate of a technical institution, and is between the ages of 16 and 19 years. This should apply not only to the regular established trades, such as machinists, car builders, blacksmiths, electricians, painters and the others now well known and employed in the electric railway field, but should also include a new trade, which for the want of a better name could be designated as an electric car repairer. This apprentice course should combine practical experience and some knowledge of a number of the regular trades, and should be well defined and of such a character as to greatly improve the ability and efficiency of the class of men to be depended upon in the future to take care of electric railway equipment, both in the general shops and in the car houses."

The resolution was referred to the incoming executive committee.

The meeting then adjourned until 2:15 p. m.

WEDNESDAY AFTERNOON SESSION

President Winsor called the meeting to order at 2:15 o'clock.

The discussion on the report of the committee on equipment was continued, taking up the subject of heat-treated axles.

Mr. Barba said that the Midvale Steel Company, Philadelphia, had just completed 700 axles for the Interborough Rapid Transit Company under Mr. Doyle's specifications which call for no ultimate strength, 50,000 lb. elastic limit, 22 per cent elongation, and 30 per cent discard. Mr. Doyle's requirements could be exceeded in the ordinary type of axle, 5½ in. in diameter, by using a very pure carbon steel properly treated. As a matter of fact, the tests actually obtained from the 700 axles very much exceeded the requirements. He was in favor of materially raising the requirements in the committee report and even to exceed the requirements of the Interborough specifications. There would be no difficulty whatever in making axles having 55,000 lb. elastic limit, and 23 or 24 per cent. elongation. This applied not only to axles, but to armature shafts, and all material of a section sufficiently small in area to permit the full effect of the applied heat treatment being felt all the way through the section. Untreated material which is represented by practically all axles now in use, would give a cold bend which will break at about 30 deg. The treated material having an elastic limit nearly 20,000 lb. higher would bend flat when cold. The cold bend is the nearest approach to a true test of the resistance of metal to what is known as "fatigue stresses." An axle was practically never bent, yet there was a common species of axle failure which was the direct result of repeated bends applied progressively on opposite sides of the exle. By making the ordinary tests, insisting that the material be oil tempered and afterwards annealed, material can be obtained which would be best calculated to resist repeated shocks and vibrations and so-called fatigue stresses.

J. Leonard Replogle, Cambria Iron Company, endorsed Mr. Barba's remarks that the tests are not quite severe enough. There were several features which were very important, but which were not incorporated in these recommendations. Among them was the question of the weight of hammers to be used in forging the billets into axles. It was a very wise thing to use very heavy hammers for the forging process, sufficiently powerful to insure thorough penetration of the blow to reach clear to the center. His company used hammers under which were forged the axles made for the Interborough, which weighed 15,000 lb. He believed that in material of this kind, subjected to severe alternating tension and compression strains, and also heavy torsional stresses, particularly in the motor axles, a very

low phosphorus content should be specified. The element of brittleness was one above all the others which should be limited to a very narrow margin.

President Winsor said that the Boston Elevated Railway put in axles seven years ago which were made to the ordinary steam railroad car axle specifications, and had no special treatment. But one axle had broken, and that was sent to Mr. Doyle. He reported that it was the worst piece of steel he had examined. About 400 of the axles have been very thoroughly examined without finding any cracks, yet new axles have been ordered to replace all of the early axles.

Mr. Taylor wanted to know what could be done with existing axles in the way of heat treatment after they had been in service some time.

Mr. Barba had no hesitancy in saying that any piece of steel whose past history or composition was known can be materially improved by proper heat treatment, unless it had already received the maximum treatment possible. If the composition of old axles was known and the conditions were favorable, they could be heat treated, turned down to a smaller size and put into service again. To the cost of the treatment should be added the cost of stripping and remounting and the machine work. If axle loads go up or the service requirements are increased in some way, where the diameter of the axle cannot be increased, the only recourse would be to better the properties of the metal. There was another point wherein the proposed specification was inadequate, and that was that it would be a wise precaution to limit the number of axles made from one ingot. The danger was one which could only be determined by very close examination, perhaps destroying the ingot to find a possible pipe in the center.

Mr. Roberts said he purchased some time ago a number of trucks, axles and wheels complete, and had a series of broken axles that became so serious that he determined to reject all the axles purchased from that particular company. He rejected all the old axles and put in new ones which had been heat treated. He had not had a broken axle since. The fractures in the first lot of axles occurred next to the gear. The wheel seat on the new axles was made ½ in. larger in diameter than the main part of the shaft.

On motion the specifications for heat-treated axles were referred back to the committee for further investigation and report.

Mr. Heywood moved that the report of the committee on equipment be accepted and printed in the minutes and that a vote of thanks be extended to the members of the committee. The motion prvailed.

Power Generation

The report of the committee on power generation was then considered. W. S. Twining, Philadelphia, presented the first portion of the report, relating to flue gas analyzers in abstract.

Charles Hewitt, Philadelphia Rapid Transit Company, said that at the last meeting of the Engineering Association he had stated that at that time that the results obtained with flue gas analyzers were somewhat misleading and apparently did not fulfill the claims made by the manufacturers. The latter seemed to be based on the assumed fact that the analyzers were analyzing the products of the combustion in the fire box. After a year's experience with two instruments in two different power houses he had reached the conclusion that this statement was not strictly true, and this conclusion was also brought out in the results published by the United States Fuel Testing Bureau. The samples of gas which were analyzed by these devices were not entirely the products of combustion, but were the products of combustion diluted by an unknown amount of infiltrated air. He had thought that some information on the subject would be of interest to the members of the association, so had put the analyzer at the Philadelphia power station in the hands of one of the company's very best engineers and started a test on a particular boiler. They first analyzed the gases without touching the boiler. The second step was to pack with an asbestor compound, made by macerating old steam pipe covering, all the iron doors of the furnace, both the front doors and the side cleaning doors. The third step was to build a temporary brick wall outside the side cleaning doors in order further to shut off any air that might be leaking in from that source. After packing the side cleaning doors and all the cracks which were visible, the blacklayer naturally started at the bottom to build the 4-in. brick wall, and as he got to the top and the space became contracted, the air which leaked in the door, although the latter was packed with asbestos, was very perceptible to the hand. The next step was to treat the brick setting with a liquid cement composed of ordinary Portland cement grout mixed to the consistency of paint. Three separate coats of this were put on. Finally on top of the three coats of paint they put a coating of Muralo, a cold-water paint with a gypsum base. The speaker had some charts showing the different steps under these different conditions. The first chart showed the boiler as it originally stood and gave results averaging about 2 per cent CO_2. The next step, with the doors packed, showed an average of about 14 per cent. The next step, with the side cleaning doors bricked up, showed 15 to 16 per cent. The final step, with the bricks in the setting treated, showed an average of about 17.5 to 18 per cent CO_2. The maximum possible was 20 per cent. This indicated the correctness of the statement made by the speaker last year that the gases in the combustion chamber were very much diluted by infiltrated air. He then showed some other charts that had not gone through the same process. One showed a bad boiler, which stood alone with side cleaning doors on both sides, front doors, back doors and comparatively little brick setting. When the test was started the average was about 4 per cent CO_2. After packing the doors as well as possible with asbestos the average was 10 to 12 per cent. The speaker was sorry he was unable to state a definite saving in coal consumption due to an improvement in reducing the air leakage. Many other things in this plant, and other plants, too, had so influenced the coal consumption that it was impossible to determine the amount. There was undoubtedly some benefit, but the tests did not show the benefits claimed, due largely to the fact that the analyses made were not solely the products of combustion.

B. F. Wood, Pennsylvania Railroad, said he had recently been interested in some tests that seemed to indicate that there was a peculiar diversity in the composition of flue gas, depending on what point in the flue the sample for analysis is taken. This might make a difference of 100 per cent and was due to the fact that the gases were not thoroughly mixed in the combustion chamber. That, in turn, depended to a large degree on the manner in which the boiler was working. If worked to its full capacity, the combustion chamber might be pretty well filled up. If worked to less capacity, the gases would flow in strata and come out of the flue unmixed. He did not think anyone could depend on an analysis of flue gases unless a complete sample was taken throughout the whole flue area, or unless the furnace construction was such as to insure complete mixture of air in the furnace.

Mr. Hewitt said he agreed with the speaker. In his early experience with these instruments he had found that almost any percentage of CO_2 could be obtained by taking the gas at different points. He also found that the most constant results were obtained by running the sampling pipe well into the combustion chamber and putting a cross-pipe across the combustion chamber and having that cross-pipe perforated. Samples of gas obtained in that way should be thoroughly mixed because the gas was being taken from across the entire combustion chamber. Samples taken in that way should give constant results. He added that the

high points in the charts which he had shown were the points of cleaning the fires. The smaller points were those when the firing was done by the fireman. These facts led the speaker to the conclusion that it was very desirable to fire small charges. In some of the charts, where the percentage was as high as 17.5, the instrument was very sensitive to the opening of the fire door. If the fireman should throw on more than eight or nine shovelfuls it would make the point at that particular time too high. Hence, in that particular test, the fireman was limited to nine shovelfuls.

President Winsor thought that the method of gas analysis afforded a very good way of studying what was going on in the boiler room and fire-room. As Mr. Hewitt had said, it showed whether the firemen were firing too heavily and leaving the door open too long, and in this way many things of interest were discovered.

Mr. Twining said that in their case it had shown that they were losing more from leaky settings than from bad firing.

President Winsor then called for the discussion on the subject of steam meters, treated in the report.

Steam Meters

Mr. Twining outlined the report of the committee on this subject.

F. E. Case, General Electric Company, described the recording-flow meter which, he said, would accurately record the rate of flow of steam in pounds per hour, in any diameter pipe, at any condition of temperature, pressure or moisture met with in commercial practice. The meter would also give an accurate record on periodically intermittent flow, such as occurred in operating steam engines, pumps, etc., as well as constant flow, provided it was recalibrated after being installed, or the arrangement of the piping would permit the insertion of the nozzle plug at a point in the steam main where the flow was constant. Since all meters were carefully calibrated on constant flow before leaving the factory, it was necessary to recalibrate only when the flow was intermittent. No change whatever in the main piping system of the station was necessary to install the meter, and as none of the steam being measured passed through it, the meter always remained cool. The meter itself might be located in any convenient place in the station, so long as it was placed on a lower level than the nozzle plug. Drop in pressure caused by the insertion of the nozzle plug in the steam main was inappreciable, even at very high rates of flow. If the temperature and pressure of the gas was constant the rate of flow in a pipe was proportional to the velocity. To measure this velocity a nozzle plug was screwed into the pipe at the point where the flow was to be measured. One set of openings, called the leading set, extended horizontally across a diamter of the steam main and faced against the direction of flow. The other three openings near the center of the plug constituted the trailing set. The steam, impinging against the leading set of openings, set up a pressure in them which was equal to the static pressure, plus a pressure due to the velocity head. The pressure in the trailing set was equal to the static pressure, minus a pressure due to the velocity head. This difference in pressure existing in the two sets of openings was communicated through separated longitudinal chambers to the outer end of the plug and from there, by proper piping, to the meter. The meter consisted of two cylindrical hollow cups filled to about half their height with mercury and joined together at the bottom by a hollow tube. This arrangement of cups and connecting tube formed a "U" tube which was supported on, and was free to move as a balance about a knife-edge. A difference of pressure in the nozzle plug was communicated to the cups by flexible steel tubing placed inside the case. This difference of pressure caused the mercury to rise in the left-hand cup and fall the same amount in the right-hand cup, until the unbalanced columns of mercury exactly balanced the difference in pressure. By the displacement of the mercury, the beam carrying the cups moved downward on the left-hand side of the knife edges. This side would descend until the moment of the weights on the right of the knife-edges exactly balanced the moment caused by the displacement of the mercury in the left-hand cup. The motion of the beam was multiplied by levers and actuated the pen which moved in proportion to the amount of mercury displaced. The time element of the meter consisted of an eight-day clock which drove the drum feeding the paper. The paper on which the record was made was so calibrated that the rate of flow in pounds per hour might be read at any instant, or the average rate calculated for a given time. Meters were equipped with a re-roll device operated by a spring mechanism and having sufficient capacity to accommodate one complete roll of paper.

Mr. Twining asked whether the instrument had been perfected so that it would register and record on a pulsating load.

Mr. Case replied that as sent out it was intended to measure a constant flow, but that it would give an accurate record on periodically intermittent flow, such as occurs in operating steam engines, etc., but it must be recalibrated for that condition. It would not work on an intermittent pulsating load as in a Parsons turbine. In answer to a question he also said, there were adjustments for moisture.

Mr. Hewitt said there were many uses for a steam meter around a power house other than measuring the flow to the main units. As a result of the committee's report last year his company had purchased three new St. John steam meters and had had these meters on several different parts of the station accessories with very interesting results. The first test made was on an air compressor furnishing compressed air for the signal system on the elevated road. This was somewhat of a pulsating load and the compressor was especially piped up at the time so that the condenser condensed all the water, in order to test the steam meter. The meter was found to be very satisfactory, although it was working very near its minimum load, yet the result was within 3 per cent of the weighed water. He had every reason to believe that on higher loads the meter would register within one per cent.

Low Pressure Steam Turbines

Mr. Hewitt referred to the two low-pressure turbines of 800 kw capacity each, which have been in service for several years in Philadelphia and have been working very satisfactorily. The economy of the station was very marked. With the turbines carrying 16 to 20 per cent of the total load of the station, the coal consumption had been reduced from an average of 4.4 lb. to 3¾ lb. per kw-hour. If enough of the turbines were installed to take all the exhaust steam of the station, the economy would undoubtedly be much better. The economy due to the installation of low-pressure turbines depended of course on the original design of the station. The percentage of economy was higher with non-condensing single cylinder engines. It was somewhat less with non-condensing compound engines, and would be still less with compound condensing engines. He believed the results obtained in New York in the plant of the Interborough Rapid Transit Company justified their use.

Mr. Twining said that nothing was said in the report regarding the minimum size of exhaust turbines that the manufacturing companies were prepared to build. So far as he had been able to learn the 500-kw size was the smallest exhaust turbine that had been put on the market. He saw no reason why smaller turbines should not be built, although the relative economy would fall off in smaller sizes. The ratio between the power developed by the exhaust turbine and the power developed by the main steam engine depended on the kind of engine to which the exhaust turbine was attached, and it would vary anywhere between 50 and 90 per cent.

M. H. Bronsdon, Rhode Island Company, thought that compound condensing engines when operated with a low-pressure turbine were really resolved into high-pressure compounding. He would expect an economy of approximately 24 or 25 lb. of steam per kw hour in sizes of 2000 kw. It might go below that, even to 22 lb. The economy of the low-presure turbine was approximately 34 lb. The low-pressure turbine, which was practically the same as the compound engine, should give an economy of about 18 lb. for the compounded unit. The steam used by the reciprocating engine bore only a small relation to the total steam used—that is to say, the consumption of steam was relatively high in the reciprocating engine and if the capacity of the low-pressure turbine, which was practically the same as another reciprocating engine, was added, then the steam consumption of the combined unit would be relatively low.

Mr. Roberts read a lengthy paper on the subject of low pressure turbines, which will be printed in abstract in a later issue of this paper.

Peter E. Mitchell, Birmingham (Ala.) Railway, Light & Power Company, asked whether there were any installations of low pressure turbines regulating properly on other than intermittent admission of live steam. Could a low pressure turbine be made to generate lighting current with proper regulation?

Mr. Twining explained that in the exhaust turbines as regularly connected there was no governor except the safety governor. For lighting service regulation was simply a question of regulating the supply of exhaust steam. When the supply of exhaust steam was very large in volume, it could not be passed through an ordinary throttle valve. He knew of one case, at the Pressed Steel Car Works, where an exhaust steam turbine was running, taking the steam from various pumps and other auxiliaries around the plant, and was operating an a. c. machine to supply the lights. About one-third of the boiler plant had been shut down since that turbine was put into service. There was a governor on the turbine to regulate it, because it was not running in parallel with other machines. As regards the combined steam consumption the conditions at the Philadelphia Rapid Transit Company's plant at Mt. Vernon Street were not ideal, inasmuch as it was necessary to use cooling towers. Any plant that is forced to use cooling towers would not be considered ideal. The installation was made because there was a shortage of power, and this was the cheapest way of getting the power. The total cost was about $80 per kw and the result as a whole had been satisfactory. The cooling tower ran the cost up. The same plant if located where water for condensing had been available could have been put in for probably not over $50 per kw. The condensed water is used over again in the boilers. This involves the use of oil separators. Where an exhaust turbine is used in connection with cooling towers, it was more of a problem to decide the proper size of condensers and the arrangement of cooling tower than the exhaust turbine. The exhaust turbine was only about half the problem. The Philadelphia Rapid Transit Company was among the first to try the exhaust steam turbine, and was now waiting for a larger unit to be installed.

Mr. Bronsdon gave some operating figures on the 5000-kw low-pressure turbine installed in the Interborough power house in connection with 7500-kw reciprocating units.

The steam consumption of the combined units was from 14.4 to 14.8 lb. per kw and the range of load from 9000 to 12,500 kw on the combined unit. The reciprocating unit running alone condensing gave an economy of about 17½ lb.

Mr. Stott, chief engineer of the Interborough Rapid Transit Company, was strongly of the impression that he would get better capacities and better economies with a low-pressure turbine, with the same normal rating as the reciprocating engine. Unless very high boiler pressures were used where a low-pressure turbine was used in connection with an engine that had been operating as compound condensing, it would be found desirable and perhaps necessary to increase the diameter of the high-pressure cylinder.

Mr. Hewitt moved that the report of the committee be accepted, the committee continued and that the thanks of the association be tendered to the committee for the work done. Unanimously carried.

Motion was made and carried that the executive committee consider the question of condensers and forced draft as subjects for the power committee for next year.

President Winsor appointed the following committee on nominations for officers for the ensuing year: Mr. Evans of Buffalo, Mr. Campbell of Seattle, Mr. Ayres of Boston, Mr. Coffin of Mobile and Mr. Twining of Philadelphia. They will report Thursday afternoon.

The meeting then adjourned.

WEDNESDAY MEETING OF THE ACCOUNTANTS' ASSOCIATION

The thirteenth annual meeting of the Accountants' Association was called to order by President Robert N. Wallis at the Hotel Savoy, Denver, at 10:10 o'clock on Wednesday morning.

President Wallis then read the annual address, which is published elsewhere in this issue. After completing his address Mr. Wallis added that he desired to call attention to the courteous acts of the Denver City Tramway Company and of others in Denver who had welcomed the members. The address of the president was accepted.

Secretary-Treasurer H. E. Weeks presented the report of the executive committee which included a resolution saying that the committee did not approve an amendment to the constitution providing for the admission of associate members. The report of the committee was accepted.

Mr. Weeks read his report as secretary-treasurer and it was accepted.

E. F. Arthur, secretary and treasurer Continental Audit Company of Denver, and J. H. Kingwill, auditor Denver Union Water Company and secretary of the Colorado Society of Certified Public Accountants, welcomed the members.

The paper of S. C. Rogers, treasurer Mahoning & Shenango Railway & Light Company, was read in his absence by W. H. Forse, Jr., treasurer Indiana Union Traction Company. Mr. Rogers was prevented from attending the meeting by sickness in his family. An abstract of the paper of Mr. Rogers will be found elsewhere in this issue.

In opening the discussion on the subject of "Interurban Statistics," F. E. Smith, comptroller, Chicago Railways, moved that the association recommend that in computing statistics, both for city and interurban roads, total car-hours and car-miles be used as the basis, instead of revenue car-miles and car-hours. The motion was seconded by W. H. Burroughs, secretary and treasurer, Memphis Street Railway.

Mr. Smith said his practice always had been to figure the revenue car-miles and revenue car-hours, but he thought this was not fair to the power department. For that reason he would be glad to have it changed. If the association said it ought to be changed he thought his company would follow.

Mr. Burroughs said his practice had been to use the total car-miles and total car-hours.

Mr. Smith said he would omit the car-hours from his motion. He wanted to include the dead car-mileage. The Chicago Railways Company had used the revenue-producing trips in computing the mileage. There were some instances where the trip from the car-house to the starting point was longer than the revenue trip, and some of the cars had gone in and out twice during the day, and it made considerable difference. The trip had to be made. Some of the cars did

not take passengers at all, and the passengers that were taken by other cars might be picked up on streets before the regular route was reached. The initial trip from the car-house in such cases did not really yield any revenue.

A. L. Linn, Jr., general auditor, New York State Railways, said that the car-mile as a unit of earnings must be based upon the revenue mileage and the car-mile for operating expenses should include the entire mileage.

W. H. Forse, Jr., treasurer Indiana Union Traction Company, asked Mr. Smith whether or not the information would be valuable as to the advisability of changing the location of the car house as a medium toward figuring the exact mileage. Mr. Smith had stated that on some of his divisions the distance from the car house to the starting point was more than the length of the regular trip.

Mr. Smith said the trip was about 1¼ miles, or 2½ miles for the round trip, but it was over two miles from the car house to the starting point by the route the cars had to follow.

H. L. Wilson, treasurer Boston Elevated Railway, said that certain of the operating expenses depended upon the entire mileage, whether it was dead mileage or whether it was revenue mileage. It seemed to him that it should all be figured. It cost practically as much to run dead mileage as it did to run the other mileage.

It was stated that one of the answers of the Interstate Commerce Commission, under its classification, had covered this point. Mr. Smith said that this decision related to the car-hour part only, not to the car-mileage feature.

M. R. Boylan, general auditor Public Service Railway, thought that dead mileage ought to be included. He included it in every instance.

W. F. Ham, comptroller Washington Railway & Electric Company, said that all were working together to produce the best classification and if the association made an erroneous decision, or if the committee should meet with the Interstate Commerce Commission and a decision should be made which it was proved afterwards could be improved upon, he had every feeling that the disposition of the commission would be to re-consider it.

Mr. Burroughs had found that his company needed information concerning the total car-miles to give the mechanical department the car-mile cost in order that it might estimate the life of wheels and the number of miles made, for showing lubricating cost per car-mile, and unless the total car-miles were used the figure would not be a true one; and if this figure should be used for the expense unit of cost per car-mile, it would certainly be right to use it for the earnings.

N. E. Stubbs, auditor United Railways & Electric Company, said this was a question in which he was very much interested and he was very glad that Mr. Smith had brought it up. He was thinking of making a report to his company about this mileage subject and he should like to have, if possible, the sentiment of the members present as to who included dead mileage and who did not, in order that he might use the information in his report.

President Wallis then asked those who included dead mileage, so-called, as part of the mileage in making these statistics to make it manifest. The proportion was about 16 who did and 7 who did not.

Mr. Linn said his properties used both, depending upon whether the revenue per car-mile or expense per car-mile was to be determined. In determining the mileage the dead car mileage was not included unless the cars hauled passengers in and out of the car-house. Their experience had been that it was preferable and advisable to purchase land more nearly in the center of the city, and thus make a saving in the dead mileage.

Mr. Ham said it seemed to him that the important point was the handling of a passenger car-mile; that was the one thing that indicated the earning capacity of a line; and, in order to get any idea of the real net earnings of a given line, the dead mileage must of necessity be added. If some lines were operated, as had been suggested, at apparently 50 cents a car-mile, but which figured, with the dead mileage included, only 40 cents per car-mile, the elimination of the dead mileage, it seemed to him, would lead to an entirely misleading statement of what the real results of that line were.

A vote was then taken on the motion of Mr. Smith and it was carried.

Mr. Forse, in order to get another phase of this subject before the convention, moved that the mileage of the trailer car and the motor car be included in that. In other words, if a motor car pulled one trailer the mileage was double what it would be in a single-car operation. In some companies "motor car-miles" were used, but they were nothing more than "car-miles." His motion was made in order to get the expression of the convention, because he knew there was a decided difference of opinion on this subject.

Mr. Ham thought that the association was already on record, and before passing upon the question, he believed it would be well to look up the past proceedings. He was not entirely clear in his recollection, but it seemed to him that the conclusion that was reached at a preceding convention was that if the train had an extra crew it should be treated as one car. If, however, the train required an extra crew, or part of a crew, it should be treated as two cars, or more, according to whether there were two or more cars in the train.

Mr. Wilson thought that possibly that was decided before the multiple unit system with large cars was adopted. It was a different problem with an interurban road than with an urban road, and he thought the matter was one that would require considerable thought to arrive at a rule that would be applicable to both classes of property.

Mr. Ham said it seemed to him that where a train was operated and each car carried a full load of people, it was entirely proper to treat those as separate cars. But if two or three small cars were operated as a train, as might be the case in some places, as a single car, that train was to all intents and purposes equivalent to one single car, and he thought it would be unwise to destroy the value of such statistics for comparison with that of any other city, to so make earnings and expenses per car-mile extraordinarily low.

Mr. Burroughs asked the representatives of interurban lines if they had ever used the ton-mile, and how they would figure the maintenance cost of the trailer cars for the mechanical department. In his company the mechanical department was given daily the report of the miles made by each car on the system. A number of trailers were run on one or two lines, and the miles for these trailers were figured separately. There was a conductor on the trailer, and if the trailer car-miles were not shown the mechanical department could not figure the cost of maintenance on the trailers. He thought the same situation would apply, perhaps, to the interurban lines. It seemed to him that if the information was to be of any value to the mechanical department the miles should be figured separately.

Mr. Forse stated that it appeared to him that there were several factors in this problem. One was the mechanical feature that Mr. Burroughs mentioned, the mileage of the wheels or the brake shoe or the trolley wheel. On the other hand, there was the cost of the power used and the wages of the crew. For instance, the mechanical department must know the mileage of each separate car, in order to determine the efficiency of the various parts. But there were so many various types of cars—the single-truck and the double-truck, the light trailers and the heavy motors—and if the power and the wages of the crews were to be figured, judgment must be used, as Mr. Hamm had stated, and it appeared to him as if, in order to get accurate statistics, especially on

interurban properties handling a great deal of freight, the roads were coming, sooner or later, to the ton-mile. That involved a great lot of work, if undertaken. He did not believe that there had been enough discussion to pass intelligently upon such a large subject. He preferred to withdraw the motion and take it up for further consideration at some future time.

A. H. Kayser, auditor, San Diego Electric Railway, moved that the entire subject be referred to the committee on standard classification of accounts. This motion was carried.

Irwin Fullerton, auditor, Detroit United Railway, read the report of the committee on interline accounting. This report is published elsewhere in this issue.

H. E. Vordermark, auditor, Fort Wayne & Wabash Valley Traction Company, said that he was using a system similar to that outlined in the report of the committee.

Robert Morrison, Jr., secretary and auditor, Michigan United Railways Company, asked if the committee would use the same kind of way-bill for local business.

Mr. Forse said that the same general plan would be used on local shipments, with the exception of the five-part way-bill. There would be the four-part way-bill and the same system of forwarding shipments would be used. The reports would only be such as were made by the station agents to the auditor.

Mr. Morrison added that in that event it seemed to him that it would be necessary to use a uniform system of way-billing; the old form for local business and the other form for interurban roads.

Mr. Vordermark said that his company had agents at junction points where shipments were transferred to foreign lines, and an abstract was made of all shipments that were transferred and this was sent in daily and checked up; it was received from foreign lines as shipments were forwarded over the lines or transferred.

Mr. Kayser did not handle any freight business on the electric line. The only place where he met this question was on steam lines. He believed the plan as outlined was a good one, although he had not followed it so far. He had used the steam line blanket way-bills, and the receiving agent made his expense bill therefrom. He thought the plan recommended by the committee, however, was an improvement on that.

H. S. Swift had one road where the blanket way-bill was used. He thought the form shown by the committee excellent. If he could get the other roads to use this form he would try to use it on an interurban line in the Toledo system. It seemed to be superior to the one in use.

H. S. Norton, Omaha, Lincoln & Beatrice Railway, asked why it was better to pay the balance.

Mr. Forse said that less money was handled and that was the principal reason, he believed, why the roads had used this plan. Companies handled a good deal of each other's money, and oftentimes at the end of a month there was very little balance in favor of either one, so that the financial transaction was not a very large one, and it was for the purpose of keeping that as small as possible that the balance plan had been used.

Mr. Swift said that an autographic way-bill machine had been used in his office.

Mr. Forse had used that for the local billing. The way-bills were printed in rolls and were arranged in the machine so that one writing did for the five copies. The agents made separate abstracts for the local and foreign shipments. They started separate pages for foreign shipments, and this record was kept separately in their abstracts, so that the agent's copy would be used. The agent made a monthly report.

Mr. Morrison was using at the present time the steam blanket way-bill. The form of way-bill recommended by the committee had many advantages over the other, and if adopted by the association he should certainly adopt it.

Mr. Kayser said the new form might not be quite as convenient as the old blanket form in checking the freight at the time it was received.

Mr. Forse said that Mr. Kayser had stated the best feature of the blanket way-bill, but the committee thought that the other advantages outweighed that. When the freight car arrived at a small station there were often wagons waiting for the freight, and under this plan the expense bill was already made up by the agent who forwarded the shipment. The agents were saved a great deal of work in that way. In handling loss and damage claims the bills were separately numbered, together with whatever notations might be on the bills, and they were kept on the papers.

President Wallis called attention to the fact that the report of the committee contained several different recommendations.

Mr. Swift moved that the report be accepted and the committee be continued. This was done.

The business next in order was the report of the standing committee on a standard classification of accounts and form of report. This report was read by W. F. Ham, the chairman, and is as follows:

Report of Standing Committee on a Standard Classification of Accounts and Form of Report

At your last convention on Oct. 15, 1908, the recommendation of this committee was adopted that the classification of operating expenses, operating revenues and expenditures for road and equipment, prepared after numerous conferences with representatives of the Interstate Commerce Commission and State railway commissions, should be adopted as the standard of this association.

Quoting from our report submitted last year: "This association has from the outset urged the importance of uniformity and inasmuch as these classifications have been adopted by the Interstate Commerce Commission and will doubtless be adopted by many State commissions, it seems most desirable that the members of this association should use these classifications, whether or not they are subject to federal or State supervision."

Since then classifications substantially conforming with the new standard classification have been adopted and put into effect by the Public Service Commission of the First and Second Districts of the State of New York and by the Railroad Commission of the State of Wisconsin.

We now repeat the recommendation that members of this association should use this classification whether or not they are subject to federal or State supervision, believing that the greatest good can be accomplished by uniformity, even if in some individual cases the classification does not seem the most desirable.

On Aug. 3, 1909, each member company of the association was furnished with two copies of a pamphlet containing the full text of the classification and at the same time copies were sent to each of the railroad commissions and the street railway associations. This pamphlet was prepared with considerable care and we trust will meet the requirements of member companies. Additional copies of the classification may be secured at a price of 30 cents per copy by communicating with the office of the association.

A number of questions having arisen with regard to the new classification, a conference was held in Washington, D. C., on April 22 and 23 between your committee and representatives of the bureau of statistics and accounts, Interstate Commerce commission. The conference was a very harmonious one and after careful consideration decisions were reached on all questions presented to that date. These decisions have recently been promulgated as an order to interstate carriers by the Interstate Commerce Commission. Through the courtesy of Prof. H. C. Adams, in charge of statistics and accounts, Interstate Commerce Commission, we were enabled to send you on Sept. 15 a copy of accounting bulletin No. 2 containing decisions in above cases, known as cases 1 to 58. All of these cases having, as above stated, received the approval of this committee, they are submitted as a part of our report.

In order to bring the matter properly to the attention of the convention, we recommend that the decisions in the above cases be approved, desiring however, that they shall first be fully discussed.

At the meeting above referred to a working arrangement was decided upon for securing uniform interpretations of the instructions contained in the classification. It was arranged that those members of the association that operate interstate roads should correspond directly with the bureau of statistics and accounts, Interstate Commerce Commis-

sion, whenever questions arose as to the proper interpretation upon instructions, and that members of the association not operating interstate roads desiring similar information, should communicate with the chairman of this committee. In either event the questions will be considered jointly by this committee and representatives of the Interstate Commerce Commission.

Your committee has passed upon a great many questions since the meeting in Washington on April 22 and 23 and the decisions in these cases will be published at as early a date as practicable.

It will be recalled that the Interstate Commerce Commission promulgated the new classifications as effective Jan. 1, 1909. It was its intention that companies should be required to rewrite their account for the six months ending Dec. 31, 1908, according to the new classification, in order that the report for the year ending June 30, 1909, should be entirely in accordance with the new classification. Our committee made representations to the Interstate Commerce Commission showing the impracticability of rewriting the accounts for the six months ending Dec. 31, 1908, and the commission decided that accounts for that period need not be rewritten, but could be reported according to the old classification.

The committee has been very active in your interests during the entire year, having kept in close touch with the Interstate Commerce Commission through meetings and correspondence on every matter in any way pertaining to accounting. It is particularly gratifying that our relations with them have been so uniformly pleasant and that we have been able to work together so harmoniously.

Soon after your last convention, C. N. Duffy resigned as a member of this committee and the vacancy so caused was filled by the appointment of F. E. Smith. Your committee desires to make public note of the valuable services rendered to this association by Mr. Duffy. He was one of the original members of this association and the original chairman of this committee, serving in that capacity for many years and giving to the association and to the work of the committee much time, thought and energetic effort.

In order that your committee may be kept as closely in touch with the sentiments of the association as possible, we desire a full and free discussion, particularly from those members who are now keeping their accounts according to the new classification, of any features of this classification which have proven undesirable or unsatisfactory. It is probable that as time goes on this classification will be modified and whatever defects have developed should then be corrected.

W. F. HAM, chairman; H. L. WILSON, W. H. FORSE, Jr., W. B. BROCKWAY, F. E. SMITH.

After the reading of the report and in opening the discussion thereon, President Wallis introduced F. W. Sweney, special examiner Interstate Commerce Commission, who spoke briefly to the members.

Mr. Ham called the attention of the members, in speaking of the decisions promulgated by the Interstate Commerce Commission, to case No. 9, the definition of a car, in which there was a departure from the former practice of the association. The car body, and therefore maintenance of cars, now included the car body and truck, electric bells and wiring, electric heaters and wiring and airbrake equipment and wiring. In the former classification that wiring was treated as the electrical equipment of the car.

Mr. Linn thought the committee was correct.

Mr. Ham said there had been considerable objection to the method of handling store expenses and shop expenses. This was covered in case No. 10. A great many companies would like to have the proper proportion of store expenses and shop expenses distributed, but in all cases the committee had ruled, to be consistent with the classification, that while a company might keep such accounts of its own as it saw fit, in making the annual reports to the commission, and as a standard, there should be one account which should cover all expenses. An important ruling was in case 32, that amounts paid to boards of public works, county officers, etc., for the right to operate cars on and across public highways, should be charged to taxes. A similar ruling was made in case 37.

Will Browne, auditor, Utah Light & Railway Company, said the new classification was considerable of an improvement over the old classification. He formerly used an adaptation of the steam road classification.

Mr. Linn said there was one very slight difference between the New York and the Interstate classifications. He had no criticisms or suggestions to make to the committee.

Mr. Burroughs had not formally adopted the classification, but used it as a matter of reference a great deal.

Mr. Morrison was using the official classification and found that it served the needs of his company very nicely. He had no suggestions or criticisms to make.

Mr. Weeks said the company with which he was connected was following the classification exactly.

Mr. Vordermark found that the classification served requirements much more fully than the old classifications. This classification had been adopted by the Interstate Commerce Commission and by the Indiana Railroad Commission in detail. His company used the classification on the city and interurban lines.

Mr. Ham thought it would be just as well to let the classification work out for itself, and that eventually every company would see the advantage of using it.

Mr. Stubbs did not use the classification entirely, but used it considerably for convenience.

President Wallis announced that further discussion would be taken up at the Thursday morning session. Mr. Wallis then announced the appointment of the following committees:

Committee on Nominations—H. L. Wilson, W. F. Ham, P. V. Burington, Irwin Fullerton and W. A. Doty.

Committee on Resolutions—W. J. Thorp, M. R. Boylan and A. H. Kayser.

ANNUAL MEETING OF MANUFACTURERS' ASSOCIATION

The annual meeting of the American Street & Interurban Railway Manufacturers' Association, held late yesterday afternoon, taxed the seating capacity of the Rose Parlor to the utmost, and many gentlemen stood up. President Joseph R. Ellicott, in opening the meeting, took occasion to thank the executive, exhibits and entertainment committees for their very efficient work. The report of the executive committee was read by George Keegan, secretary-treasurer. Among other matters the speaker referred to the attendance at the successful Denver convention, saying that on Wednesday morning the attendance of men was 1400, which was within 100 of that at Atlantic City last year at the corresponding time, despite the distance of Denver from the Eastern centers of population. The finances of the assoiation were shown to be in a very satisfactory condition. The report was accepted with applause.

After some matters of general business had been discussed, President Ellicott was instructed to appoint a committee of three to express to the citizens of Denver the thanks of the association for their unbounded hospitality. A special resolution of thanks was extended to the exhibits committee, which has done its work under the direction of K. D. Hequembourg. The concluding business was the election of five members of the executive committee. A nominating committee was appointed by President Ellicott, and on its recommendation Charles C. Peirce, General Electric Company, Boston; K. D. Hequembourg, Walker & Bennett Manufacturing Company, New York; Henry C. Evans, Lorain Steel Company, New York, and A. H. Sisson, Forsyth Bros. Co., Chicago, were re-elected. W. L. Conwell, Westinghouse Electric & Manufacturing Company, New York, was elected to succeed W. M. McFarland of the same company. The holdover members of the executive committee are Otis H. Cutler, W. H. Heulings, Jr., Howard E. Martin, Arthur S. Partridge, E. M. Williams, Charles C. Castle, Joseph R. Ellicott, C. S. Hawley, James H. McGraw and J. K. Porter.

TUESDAY MEETING OF THE TRANSPORTATION & TRAFFIC ASSOCIATION

The second meeting of the Transportation & Traffic Association was called to order at the Auditorium Hall Oct. 6, at 9:50 a. m. by President C. Loomis Allen.

President Allen announced the appointment of the following committees:

Committee on Nominations: E. F. Peck, F. I. Fuller of Portland, and H. A. Nicholl.

Committee on Resolutions: P. P. Crafts, J. H. Pardee and H. W. Blake.

President Allen then called upon Mr. Crafts to read the report of the committee on express and freight traffic.

Mr. Crafts prefaced the reading of the report by saying he thought it would be evident that although interurban railways can profitably handle freight and express matter, they could not do so if their roads were operated for the purpose of handling freight only. In other words, freight and express traffic on interurbans was merely an incident in the earnings, the passenger earnings being the principal object for the construction and operation of the road. Mr. Crafts then read the report, which is published elsewhere in this issue.

F. J. Hanlon, Mason City & Clear Lake Railway, Mason City, Iowa, said he thought they were possibly the first road to have through tariffs with steam railroads. Their freight rates were based on the rates charged by the paralleling steam line. On passenger fares they were higher than the steam rate. For instance, between Mason City and Clear Lake, the Chicago, Milwaukee & St. Paul steam rate was 19 cents, while the electric rate was 25 cents. They depended on the service entirely to get them the business.

H. A. Nicholl, Indiana Union Traction Company, said that about 10 per cent of their gross earnings came from their freight and express business. They had separate terminals in some of the larger cities, and in the smaller ones they had a combined freight and passenger agent. They did considerable advertising of their freight business, and devoted one issue out of every three of their monthly magazine to the subject of express and freight. This magazine was then mailed to the various shippers, wholesalers and retailers throughout the district. The company was doing only a state business, not an interstate business. In the larger cities where they had the separate freight terminals and sidetracks as well, they did not solicit a great deal of carload business except livestock, and did not attempt to handle coal or lumber or things of that character. They had done some carload business in gravel and stone, but that was because of quarries located adjacent to the line. The company had not done an interchange business with any steam railroad, and had no through rates with them, nor through tariffs. It was earning about 50 cents a car-mile, or about $45 to $48 per car per day. They also handled express not only for their own company, as it were, but also have a contract with the United States Express Company, which provided for payment on a percentage basis. The express business handled independently was conducted under the name of the Merchants' Dispatch. They handled most of their business on passenger cars and at rates of about 1½ times the first-class freight rate, the minimum rate being 20 cents and 25 cents being the minimum charge.

Discussion on Operating Expenses of Freight Traffic

Mr. Hanlon then discussed the possibility of determining the actual operating expenses of the freight car movement and thought it would be difficult to do this accurately.

Mr. Crafts said they divided up their operative expenses on a car-mile basis between freight and passenger cars. He thought it was a fair assumption that a high-speed passenger coach operating at 50 m.p.h. and over would entail as much wear upon the track, etc., as a freight car operated at 25 m.p.h., even if the freight car was more heavily loaded.

R. C. Todd, Indianapolis, said that the Brooklyn Rapid Transit Company charged its freight equipment at one time with an arbitrary rate of 14 cents.

Mr. Hanlon was of the opinion that a freight car would not do more damage to the track than the average heavy interurban car, mainly on account of the speed. They took very few of their freight cars over street special wark.

A. H. Mackay, general traffic manager, Puget Sound Electric Railway Company, said that line was about 40 miles long and they operated three-car passenger trains, frequently with two-car second sections, with some short hauls between. They had an hourly service with the three-car passenger trains. They also operated two special runs in between, one from Puyallup to Seattle and one between Renton and Seattle. They earn from $12,000 to $14,000 a month on their interurban lines, so that they have to handle considerable freight. They handle from 3500 to 4000 gallons of milk every morning and receive from private companies refrigerator cars built especially for handling beef. The company averaged about five carloads of fresh meat every night. The only drawback at the present time was the terminal facilities at Seattle. They handled everything except livestock and their rates were based on those charged by the steam roads. They had the strongest kind of competition from two steam roads—the Chicago, Milwaukee & St. Paul and the Northern Pacific—and also from the boat lines. They relied very largely on quick dispatch. They watched their freight claims very closely, and last year these claims averaged less than 0.25 per cent of their freight earnings. That figure included all losses, whether from accidents or damage. Their total expense for freight, he thought, was about 45 per cent of the earnings. In answer to a question, Mr. Mackay said their charge for milk was 1 cent a gallon for the first 10 miles and beyond that 1½ cents a gallon. That also included the return of the empty cans. The longest haul on milk was about 32 miles, but the general average was about 20 miles.

F. A. Boutelle, Puget Sound Electric Railway Company, added that besides the freight business mentioned by Mr. Mackay, the company was also handling from 15 to 30 cars of coal per day from Renton. The haul averages about 12 miles.

President Allen in discussing the difficulty of arriving at a proper charge against freight cars quoted the following incident: A number of years ago in the south a road about 75 miles in length was seeking to finance some of its securities and elaborate statements were prepared and presented to the bankers in the financial centers. Various experts were sent to examine the property and they reported that the property was all right. While the territory was thin, it certainly had a heavy revenue, particularly from freight. One of the former railroad commissioners of the State of New York was retained by a trust company to examine the property. In analyzing the gross receipts, he found that the earnings from the smallest station were the largest. He went to that station and asked that the agent would show him from what source that revenue was derived, and it was found that the greatest source of revenue was a gravel bed, the gravel being loaded into the cars and the earnings charged up at the full rate, the gravel being deposited under the track of that road. Mr. Allen said the difficulty of determining the cost of freight operation was not confined to the electric roads. It was just as serious with the steam roads.

George W. Parker, Detroit United Railways, also thought it a serious question. He had recently been asked to appear before the Railroad Commission of his State and give testimony on the cost of freight operation. The opposing counsel took the ground that the handling of freight and express on electric cars should be done much cheaper than with

(Concluded on page 752.)

ADDRESS OF PRESIDENT WALLIS TO THE ACCOUNTANTS' ASSOCIATION

The thirteenth year of the existence of the Accountants' Association has not been as spectacular or exciting as its predecessor, but it has been amply eventful to emphasize the value of the association and to justify the wisdom and foresight of those who organized it. We began the year with a new classification, much different from the old, but still representing in a large part the principles to which this association has been committed after years of formulative labor. This classification is practically identical with the official classification of the Interstate Commerce Commission, in shaping which your representatives—the classification committee—were accorded an important part. They, in turn, had the benefit of your advice through your replies to the earlier tentative classification and your discussions for years in conventions. Their co-operation in the work of preparing an official classification by the Interstate Commerce Commission had been asked and given in the interest of uniformity. Uniformity had been from the very inception of this association its rallying cry.

Had all the electric railways of the country come under the jurisdiction of the commission uniformity would have been attained by manifesto. The greater number of companies do not come under its jurisdiction. In some States the law compels the adoption of the system of accounts prescribed by the Interstate Commerce Commission. In others the policy of the State regulating bodies is to be guided largely by the national commission. But still there are very many States in which there are no accounting requirements or no obligation by law or policy to follow the lead of the Interstate Commerce Commission. In the interests of uniformity in electric railway accounting, therefore, it is well that complete co-operation and harmony exist between this association, the official representative in accounting matters of the electric railways of America, and the National and State commissions. This, I am glad to say, is the case. We are working in harmony with them and we may well take a just pride in the influential position which he hold in their confidence. It is our duty to so maintain our standard of fairness and intergrity in accounting methods that we shall continue to justify their confidence, which will be ours so long as they are satisfied that we are striving for correct principles of accounting. For this confidence we are indebted in large measure to our classification committee, which has labored hard and conscientiously during the year. I call your attention especially to that part of the report of the classification committee which refers to its conference with representatives of the Interstate Commerce Commission to consider rulings upon questions which had been asked of the commission concerning the new classification.

This classification has been before you for a year and you have had a chance to study it and observe its workings. It is within the province of this convention to consider it and to offer suggestions for its improvement wherever desirable. Your classification committee represents you and in no way can it know and understand your opinions, experiences and requirements unless they find expression.

The great work of this association is still the formulation and recognition of the correct fundamental principles underlying electric railway accounting. This was the reason for its inception; it is the reason for its existence today. We are passing through a period of increasing regulation by public bodies which affects the accounting possibly more than any other branch of the electric railway industry. Different regulating bodies naturally take differing views of the principles of accounting. In the interest of the electric railway business it is the duty of this association, therefore, to consistently maintain its position of authority in electric railway accounting methods. This it can do only by sincerity of purpose and by a constant keying up to the highest standards. If its aims are recognized as conscientious (and I believe they are universally so considered) the influence of this association will be far-reaching enough to secure the fundamental uniformity for which it has so long and successfully worked. We can only accomplish this by showing to the satisfaction of executive officers, bankers, commissions and public accountants that the principles which we uphold are sound and based upon the foundation of solid reasoning.

An official visit in June as your representative to the Central Electric Railway Accounting Conference was, I believe, productive of much good in the encouragement of the aims of the smaller body and in establishing close relations between the two. From observation of this conference at close range I am of the opinion that such local organizations, furthering the aims of this association and working in harmony with it, might well be encouraged. As you are aware, many similar national organizations have local branches or allied organizations.

This organization can expect to meet but once—or, at most, as is suggested elsewhere, twice—a year. A neighborhood organization of electric railway accountants can meet profitably much oftener with the result of better acquaintance and more detailed, thorough and intimate discussion of topics of common interest. With frequent meetings, less distances to travel to attend meetings and the more general acquaintanceship formed in such close range conferences, much more intimate detail of discussion can be undertaken than is possible in a national association. Such organizations can encourage by precept and example among those who do not or cannot attend our conventions a high standard of accounting methods. Better acquaintance of neighbors in the same profession leads naturally to higher standards. As the chairman of the Central Railway Accounting Conference aptly put it, the experiences gained in the smaller organizations would better prepare their members for work in the larger association.

For the best interest of all concerned there should always be a close sympathy and co-operation of purpose between this and any local organization of railway accountants, for whatever reason formed. Such organizations should be encouraged to strengthen the purposes of this association to the end that electric railway accounting may rise continually in dignity and usefulness.

During a discussion of the question of a separate meeting time and place of this and the American Association it was suggested by a valued member of this association that in addition to the convention and annual meeting to be held with obvious advantage at the same time with the American Association, there be a mid-winter conference of this association separately. This should be exactly what the term conference signifies, without formalities and without business. The idea certainly has merit and I am glad to give the suggestion publicity.

Second only to its aim for uniformity of accounting methods, and perhaps even paramount to that, this association has always before it the work of putting higher the high-water mark of electric railway accounting efficiency. Through education, through continued insistence upon the dignity of our profession, through holding up a higher standard to attain, this association can do an inestimable service for our industry and the public. It must be continually kept in view in planning the work of the association that its duty is always to raise the standard of efficiency of its membership and of the profession which it represents. It is well, therefore, that we are to discuss at this convention the place of the accountant in the electric railway organization. We may well hope that this discussion will be thorough and that we may receive from it inspiration to higher ideals and added enthusiasm for our work. Also that it may tend to impress those not accountants, who chance to read the

report of this convention, with the dignity of our calling.

When we speak of uniformity of accounting we quite naturally have in mind an authoritative and generally accepted system of accounts, but there are other parts of our work in which uniformity of method is just as desirable. A great many of the statistics which we compute from our bookkeeping are valuable only in comparison, not only with like statistics of our own road, but of other roads as well. It is important that accounts should be so kept that comparisons may be made between roads; just as important is it that the computations which are the basis of our statistics should be so made that comparisons may be accurate. This association, therefore, has as an important work the formulating of uniform methods of computing statistics—notably of car-miles and car-hours. In Mr. Rogers' suggestive paper, which is to be read later in the session, occurs this sentence: "It would clear up the situation considerably if some uniform plan of computing car-hours and car-mileage could be formulated and agreed upon by the Accountants' Association." With the sentiment so expressed I agree. Methods of computing these statistics have been under discussion at various times, but no steps have ever been taken looking to the formulation of exact rules and instructions which should be available to members and a guide to the electric railway accountant as our classification of accounts now is. This seems to me to be desirable.

In the interest of similar uniformity steps were taken at the last convention at the suggestion of Mr. Simmons of the Engineering Association, in his address before us, to formulate a plan of cost accounting for shop, track and power station work. Previous investigations had disclosed a woeful lack of uniformity in methods of keeping data for this purpose and our engineering brethren were right in calling our attention to their needs and demanding that figures of cost given to them should be comparable. Work had been done in previous years by joint effort of the two associations and a valuable start made. A committee of the two associations was formed by vote of the last convention and has made excellent progress upon the work which is one of great magnitude. I suggest that this important work be continued the coming year and be vigorously pushed to a final completion.

In the last few months there has come upon us a new development in corporation accounting—the corporation tax feature of the tariff law. So utterly have accepted principles of accounting and, in our industry, other Federal and State requirements, been set aside by this measure that confusion seems likely. I shall not rehearse the conditions of this act or the attempts which have been made, both before its passage and since, to reasonably modify it. With these you are undoubtedly familiar. In this instance the corporations of our industry are only a very small portion of those affected. So it would seem as though some general agitation would be undertaken to modify what have been called "the injustices and inconsistencies" of this law. In such action this association should have a potent influence. I recommend, therefore, that action be taken by this convention which shall at least authorize the executive committee to take action in case conditions warrant it.

I wish to call attention again to the fact that the main value to the individual in these convention sessions lies in a thorough discussion of the subjects presented. I hope that everybody will take part. It is not so much your duty as your privilege to do so and no one need be deterred from a feeling of modesty or from stage fright. You are not before a board of examiners, but among friends. Everybody has ideas which will be of value to the rest of us and we ought to get at them.

During the year C. N. Duffy resigned from the committee on a standard classification of accounts, on which committee he had performed yeoman service. Much to my regret it seemed inevitable that Mr. Duffy's resignation must be accepted. I appointed in his place F. E. Smith of Chicago, whose valuable services in the past had well earned this appointment. Following the instructions of your last meeting I appointed as a committee upon shop accounting for joint work with a similar committee from the Engineering Association C. L. S. Tingley, P. S. Young and F. N. Lasher.

Again I wish to express for you your indebtedness to your able classification committee. You probably have little idea of the amount of work which devolves upon them. Their only reward can be satisfaction in work well done and that reward can certainly be accorded them.

The spirit of willingness to respond to all demands for service which has been shown by all members of the association who have been called upon is remarkable and certainly indicates a healthy condition of our vigorous association.

REPORT OF THE COMMITTEE ON INTERLINE ACCOUNTING*

By Wm. H. Forse, Jr., Chairman; Irwin Fullerton and Chas. L. Wight

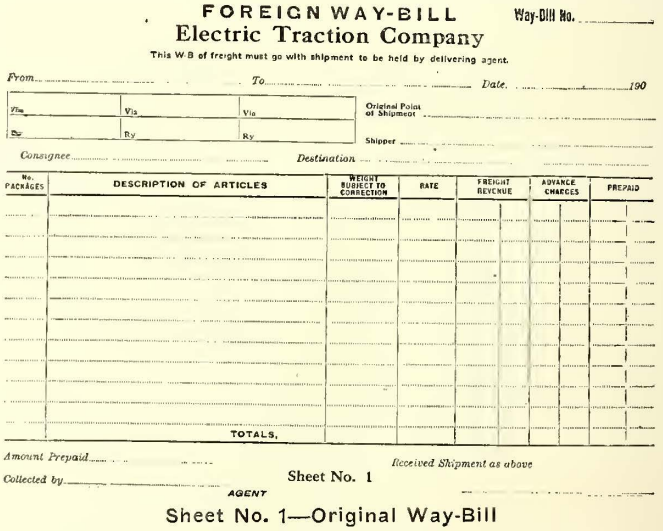
We have not attempted to cover the entire field represented by our subject, but rather to state a few general principles as a foundation upon which may be reared by future members of the committee a complete and serviceable accounting plan adapted to the needs of electric railways engaged in interline transactions.

Recommended Practice Governing Interchange Between Electric Railways

The following methods are recommended as rules of practice to govern the interchange of business between electric railways:

Passenger Accounts

Reports of ticket sales made by a railway during a given month should be furnished by the selling line to each line



FOREIGN WAY-BILL
Electric Traction Company
This W.B of freight must go with shipment to be held by delivering agent.

Way-Bill No. _____

From _____ To _____ Date _____ 190

Via | Via | Via
Original Point of Shipment
Via | By | By
Shipper
Consignee _____ Destination _____

No. PACKAGES	DESCRIPTION OF ARTICLES	WEIGHT SUBJECT TO CORRECTION	RATE	FREIGHT REVENUE	ADVANCE CHARGES	PREPAID
	TOTALS,					

Amount Prepaid _____ Received Shipment as above
Collected by _____ Sheet No. 1
AGENT

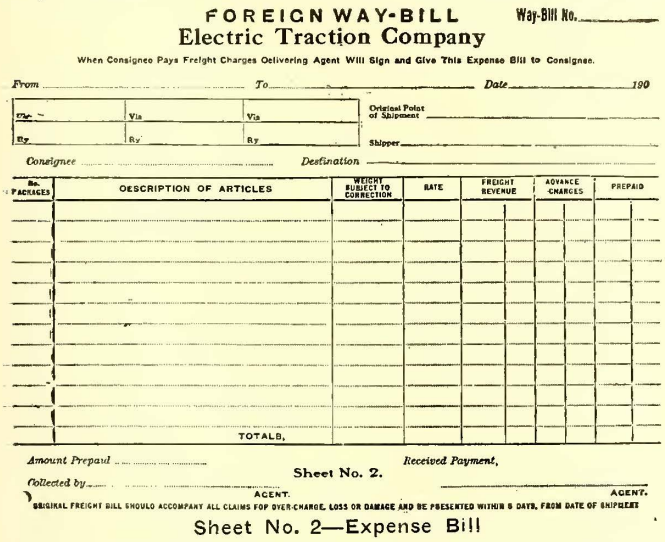
Sheet No. 1—Original Way-Bill

over which it has sold interline tickets. For example, if a ticket has been routed over four different lines each of such lines should be furnished by the road that sold the ticket with a report giving the date of sale, number, form, starting point, destination and selling price of each such ticket sold. In addition to the foregoing information the report should show the proportion of the revenue to which each road participating in the carriage of the passenger is entitled. These reports should be furnished for each calendar month as soon after the close of said month as possible and in no instance later than the 15th day of the month succeeding dates of sales.

*Abstract of report read before the American Street Interurban Railway Accountants' Association, Denver, Colo., Oct. 4, 5, 6, 7 and 8, 1909.

In making settlements for interchangeable mileage or coupon books an opposite course must necessarily be followed and reports (bills) be rendered by the road collecting the coupons instead of the road selling. The coupons collected by a railway during a given month are sent by it to the road which sold the coupons, together with a bill for the amount due therefor and settlements made in the same manner as for other interline transactions.

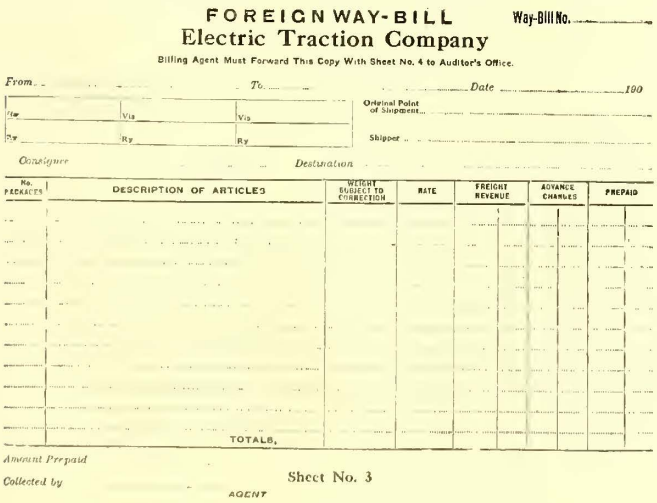
The blanket waybill, as is generally understood, lists the shipments to or from several consignees or consignors on


FOREIGN WAY-BILL Way-Bill No.
Electric Traction Company
When Consignee Pays Freight Charges Delivering Agent Will Sign and Give This Expense Bill to Consignee.
From To Date 190
Via Via Via
Ry Ry Ry
Original Point of Shipment
Shipper
Consignee Destination
No. PACKAGES | DESCRIPTION OF ARTICLES | WEIGHT SUBJECT TO CORRECTION | RATE | FREIGHT REVENUE | ADVANCE CHARGES | PREPAID
TOTALS,
Amount Prepaid Received Payment,
Collected by
AGENT. AGENT.
ORIGINAL FREIGHT BILL SHOULD ACCOMPANY ALL CLAIMS FOR OVER-CHARGE, LOSS OR DAMAGE AND BE PRESENTED WITHIN 6 DAYS, FROM DATE OF SHIPMENT
Sheet No. 2.

Sheet No. 2—Expense Bill

the same sheet, while the so-called "unit" type of billing consists of a separate waybill for each shipment. The latter type of bill is one application of the loose-leaf idea, which has been adopted to such a wide extent in recent years. The electric railways doing an interline business have been quick to see the "unit" bill's advantage over the traditional "blanket" waybill of the steam railways. The unit bill, as used for interline shipments, generally consists of five parts, namely, original waybill, forwarding agent's copy, two audit copies and an expense bill, all of which may be prepared at one writing by the forwarding agent with his indelible pencil and carbon paper.

This type of waybill is used by the largest four interur-

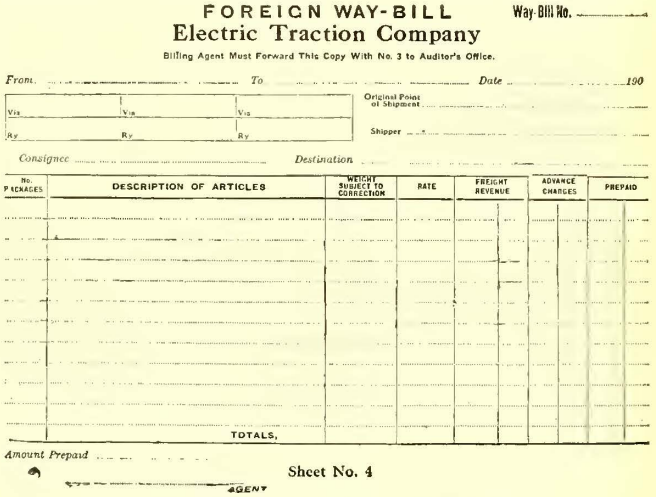

FOREIGN WAY-BILL Way-Bill No.
Electric Traction Company
Billing Agent Must Forward This Copy With Sheet No. 4 to Auditor's Office.
From To Date 190
Via Via Via
Ry Ry Ry
Original Point of Shipment
Shipper
Consignee Destination
No. PACKAGES | DESCRIPTION OF ARTICLES | WEIGHT SUBJECT TO CORRECTION | RATE | FREIGHT REVENUE | ADVANCE CHARGES | PREPAID
TOTALS,
Amount Prepaid
Collected by
AGENT
Sheet No. 3

Sheet No. 3—Auditor's Copy

ban railways in Indiana and Ohio, aggregating about 1600 miles of trackage, besides a great many smaller lines in these and other States. It has also been adopted as a standard by the Central Electric Accounting Conference, whose membership embraces the principal electric railway lines of the Central States. For the various reasons stated your committee strongly recommends the use of the unit type of waybill.

Each railway receiving interline freight shipments should render reports of such shipments not later than the 15th day of each month to the lines which forwarded them during the previous calendar month. These monthly reports, itemizing the waybills, should be accompanied by sheets showing the total amount of business between the various stations and the proportion of revenue that is due each railway rendering service.

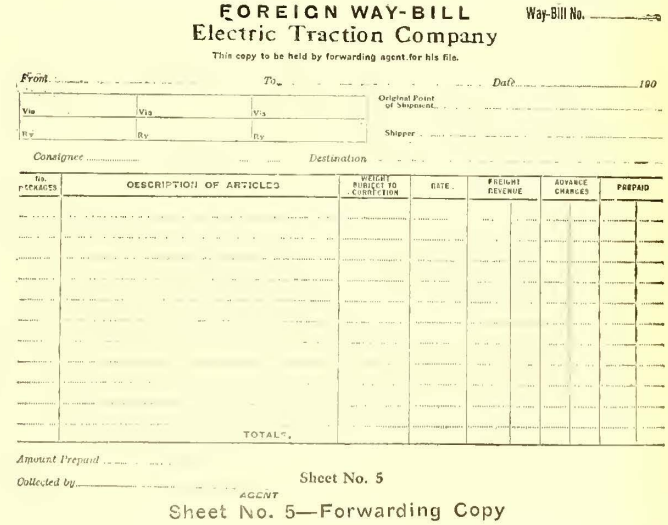
If freight traverses three or more lines enroute to destination each line that has participated in the haul should be furnished a report by the line upon which the final destina-


FOREIGN WAY-BILL Way-Bill No.
Electric Traction Company
Billing Agent Must Forward This Copy With No. 3 to Auditor's Office.
From To Date 190
Via Via Via
Ry Ry Ry
Original Point of Shipment
Shipper
Consignee Destination
No. PACKAGES | DESCRIPTION OF ARTICLES | WEIGHT SUBJECT TO CORRECTION | RATE | FREIGHT REVENUE | ADVANCE CHARGES | PREPAID
TOTALS,
Amount Prepaid
AGENT
Sheet No. 4

Sheet No. 4—Foreign Line's Copy

tion point is located. Under this plan the forwarding line is not required to make monthly reports of shipments sent over other lines. It should, however, furnish to each line interested a daily list (or carbon copies) of all waybills forwarded. The five-part unit type of waybill provides an extra audit copy for this particular purpose.

The foregoing plan governs the accounting for audit settlements only, or freight business settled through the auditors' office, as distinguished from junction settlements which are made between the agents at junction points daily or at periodical intervals. No plan of accounting is here outlined for junction settlements as they consist principally of payments and collections by the station agents them-


FOREIGN WAY-BILL Way-Bill No.
Electric Traction Company
This copy to be held by forwarding agent for his file.
From To Date 190
Via Via Via
Ry Ry Ry
Original Point of Shipment
Shipper
Consignee Destination
No. PACKAGES | DESCRIPTION OF ARTICLES | WEIGHT SUBJECT TO CORRECTION | RATE | FREIGHT REVENUE | ADVANCE CHARGES | PREPAID
TOTALS,
Amount Prepaid
Collected by
AGENT
Sheet No. 5

Sheet No. 5—Forwarding Copy

selves and there is little or no interchange of reports by the accounting departments. The junction-settlement plan relieves the auditor's office of considerable work if competent agents are on duty at junction stations. For that reason and as this plan obviates the extension of monthly credits to connecting lines, it is sometimes considered better practice to make all settlements junction settlements.

Methods of Settlement

In order to avoid excessive delay the settlements between companies should be made upon the basis of the reports

that have been exchanged unless they appear to contain errors that are of importance relative to the total amounts involved. Ordinary corrections and the correspondence usually required in connection therewith should not be permitted to delay monthly settlements. The corrections required in the reports for one month may better be taken care of at the next monthly settlement date. The cash settlements for each month's business should be made not later than the 25th day of the succeeding month, and the company owing the larger amount should pay the difference between the amount it owes and the amount due it from the line with which it is making settlement, instead of each paying the other the gross amount due. The actual payment of cash may be made by drawing voucher or authorizing the use of interline bank drafts, as may be agreed upon by the companies participating in exchange of business.

EXPRESS AND FREIGHT TRAFFIC ON INTERURBAN LINES

By S. L. Vaughan, Traffic Manager, Grand Rapids, Grand Haven & Muskegon Railway

For convenience and to take up each phase separately, I have divided freight traffic into six subjects:

First.—Tariffs and Classifications.
Second.—Solicitation.
Third.—Overs, Shorts, Bad Orders.
Fourth.—Claims.
Fifth.—Revenue.
Sixth.—Accounting.

Tariffs and Classifications

The first step to be taken before you can handle a pound of freight, either State or interstate, is to file your tariffs and classifications. The Michigan Railroad Commission requires a tariff 10 days before effective and the Interstate Commerce Commission 30 days.

The road represented by the writer is engaged in both State and interstate traffic, being in direct competition with the Grand Trunk Railroad between Grand Rapids and Grand Haven, and a keen competitor of the Grand Rapids & Indiana Railroad between Grand Rapids and Muskegon.

Our freight rates are the same as our steam line competition. Class rates are as follows: First, 17 cents; second, 15 cents; third, 11 cents; fourth, 9 cents; fifth, 6 cents. (Mileage, Grand Rapids and Grand Haven, 34.6 miles; Grand Rapids and Muskegon, 39.8 miles.) It is necessary to carry a few commodity rates in order to compete with the steam lines. When the road was built in 1902, only four classes were published in our local tariff, but later it became necessary to carry five classes, which covers all less than carload shipments and some carload classes.

Our local tariff carries, under special commodities, flour and feed (carloads minimum, 35,000 lbs.) 4 cents per cwt.; beer (minimum, 30,000 lbs.) 6 cents per cwt.; hides (minimum, 30,000 lbs.) 6 cents per cwt. These rates apply from Grand Rapids to Grand Haven and Muskegon. The beer formerly was carried in refrigerator cars and in summer time was iced. We convinced the brewery people that we could handle their shipments in carloads and save them the ice on account of our ability to get the beer to destination two hours after loading. We are now handling two cars a week during hot weather. In the winter time we get the business because we can get the shipments to destination before they can freeze.

The Milling Company at Muskegon failed and that market was compelled to look elsewhere for its goods. The Grand Rapids & Indiana Railroad was favored with the business for a time. We explained to the shippers that we had 40,000 lb. capacity cars which could be loaded 10 per cent above their capacity, that we would unload our cars promptly on arrival, as we needed our equipment, and that we would have our warehouse force make delivery to various consignees on their orders, while the steam lines took a receipt for the carload lot as a whole and paid no more attention to it, each man going to the car and helping himself. This was a point in our favor and we have been obliged to increase our warehouse room at Muskegon. We are now handling two to five cars of flour and feed per week from five shippers in Grand Rapids, all located on steam road sidings.

Another commodity handled is wheat in carload lots from Berlin to Grand Rapids, a distance of 11 miles, at 4 cents per cwt. This business formerly moved via the Grand Trunk Railroad, but the shipper said he would sack the wheat if we would make the same rate as the Grand Trunk Railroad.

Our local tariff also carries a rate on milk of 1½ cents per gallon between any two points, cans returned free. The milk business is carried only in express cars and has never amounted to very much on account of creameries located at our best dairy stations.

The express business as handled by our lines is not very extensive, as we have only two combination cars and they are used mostly in the Chicago steamboat service. On any of our passenger cars, we charge 40 cents each for packages, the rate being made high to discourage the business. The agents make a regular freight waybill, add "express" after the number, and send a copy to the auditor's office. We have a contract with the American Express Company, covering our terminals and allowing privileges in our freight cars only.

Concerning tariffs for interstate traffic: We have tariffs in connection with the Goodrich Transit Company to and from Chicago.

Now comes the interesting part to you who have endeavored to have steam lines concur in your tariffs. We are in a position to handle all freight offered us consigned to all points beyond Chicago. Previous to the time the Interstate Commerce Commission required the filing of tariffs and concurrence by the lines party thereto, the various roads out of Chicago accepted our business and it looked good to them since we used the all-rail rates and the all-rail percentages. After conditions changed and tariffs were necessary, these lines, with one exception, filed non-concurrences with the Interstate Commerce Commission. Calling on the various general freight agents of the different lines out of Chicago, with our argument that our case was not similar to any other electric line condition in the country, inasmuch as all the business we gave them must be through a steamboat line of 112 miles with which they already had tariffs and from which they were glad to get business (the main argument of the steam roads that the electric lines had no equipment to exchange not applying in our case, Lake Michigan being between our terminals), I was told that I had a good line of argument but that the western trunk lines had agreed not to prorate with electric lines. Quick action was necessary. Grand Rapids, Grand Haven and Muskegon are all in the same rate group on business beyond Chicago—in other words, Grand Haven rates apply from Grand Rapids—so upon filing a free tariff covering movement from Grand Rapids to Grand Haven we were made party to all tariffs to which the Goodrich Transit Company was a party covering all lines south, west and northwest from Chicago. The Goodrich Transit Company filed a special division sheet allowing us the same proportions on western business as on Chicago proper. The Interstate Commerce Commission accepted both and placed them on record. We now have through tariffs with the Chicago & Eastern Illinois; Chicago, Cincinnati & Louisville and Chicago Great Western Railroads, and more coming in. Some of the larger lines are still holding out, but we are in a position to accept all business offered and protect the all-rail rates.

Our tariffs are governed by the official classification and exceptions as published. We have adopted this classifica-

tion on account of being in the Central Freight Association territory. The steam lines publish exceptions and we endeavor to adopt the same exceptions. I might add the troubles encountered in becoming a party to the official classification: We filed power of attorney with the compiler and were shown for several months in front cover with lines which are shown as parties, but when this was discovered by some steam road official we were notified that it would be necessary for us to do our own filing with the Interstate Commerce Commission and the Michigan Railroad Commission, which is now being done.

Solicitation

The solicitor is the live wire which connects his company with the shipper and must hear all complaints as to service, breakage, rough handling, etc., and give such complaints attention. He should be a man of good address, well posted as to rates and classification and the time he is making on most important points; time is a strong talking feature, as shippers desire fast service and prompt delivery.

The great disadvantage generally encountered by interurban lines in large cities is the location of the receiving station. Our receiving station in Grand Rapids is centrally located near the wholesale and retail district and near our competitors' main houses, although the steam lines have receiving houses for less than carload shipments at the north and the south end of the city, and even the factories located near these receiving houses draw to us on account of the time we can make on their shipments.

A solicitor has to overcome the so-called ferry or trap cars operated by steam roads which they place at factory doors for loads of 6,000 lbs or over for less than carload shipments taking the car to the freight house, where the shipments are transferred to cars loaded to various points. The Interstate Commerce Commission has ruled that the practice is the same as cartage. The steam lines now assess a small charge of $3 per car. With all these conditions, however, I note by our Grand Rapids freight agent's July comparative statement an increase of $1,245.32.

A local agent can be of great help to the solicitor by giving patrons courteous treatment on the telephone and giving correct information.

Our westbound business consists largely of furniture, carpet sweepers, candy, brass goods and embalming fluid; eastbound, all kind of grocery sundries, plumbing supplies, and articles not manufactured in our home city. We have all-rail lines "in the clear" when it comes to time having a car leaving Grand Rapids at 6:15 p. m., which goes directly to the dock at Grand Haven and is unloaded directly to the boat arriving at Chicago at 6:00 a. m. Freight for points beyond Chicago is transferred the same day, going directly to through cars for all points with no switching or terminal delays. On eastbound business the Goodrich Transit Company receives freight up to 6:00 o'clock in Chicago and we have two cars on the dock at Grand Haven every morning waiting for the Chicago boat. Freight is taken directly from the boat to these cars and arrives in Grand Rapids from 6:30 to 7:00 a. m. and is ready for delivery shortly after. This is a good talking point in solicitation. Another argument used is: "We are a short line; give us what we can handle; the steam lines cover so much territory you can favor them with business we cannot touch." Another argument and a good one is that if it were not for the interurbans the steam roads would raise their rates, and it is a fact that we have been approached on this subject by the Grand Rapids-Chicago lines.

Where an interurban line is compelled to rely wholly on local business, it behooves the traffic man to study local conditions as to soil, etc. In what can he interest the producers along his line that will give him business? What are his competitors handling that he can handle if he has equipment of the proper capacity? Our line runs through a country adapted to the raising of small fruits, and we have interested a canning company at Grand Rapids to solicit the farmers to raise peas, beans and such produce as is used in a canning factory. The grower is not confined to the Grand Rapids market alone, but is at the very door of Chicago and Milwaukee. We have two fruit loading platforms now and I think that within the next year or two we shall see a large increase in our fruit business.

The interurbans are the people's railroads and they expect much of you. One man for whom we erected a fruit loading platform eight miles east of Muskegon asked me if we could not bring his coal out to him. Another man, building a new school house at one of our smaller towns and close to our tracks, built a platform so that our crews could unload his freight.

We have three solicitors in Grand Rapids—one placed in the territory by the Goodrich Transit Company, one who works in our city ticket office forenoons (working on the street afternoons), and myself—looking after through, as well as local, freight business.

Proper Handling

After the business has been secured through solicitation the next important item is to properly handle it to the satisfaction of the shipper and consignee, giving prompt delivery after shipment has reached destination, proper weights and rates. Our system is the same as that of steam roads, the uniform bill of lading and the steam road forms of way and expense bills are used.

The first step between the shipper and the transportation company is when freight is delivered at the warehouse door. The receiving man should be careful to see that the marks on freight agree with the shipping order and that all old marks are obliterated. Enough care is not taken here, and I can trace numerous claims back to this point. The receiving man must be positive he gets all the goods receipted for, as his receipt is the vital point between the shipper and the transportation company. All exceptions as to condition upon delivery must be noted on the shipping bill to properly protect against claim, and check marks should be placed after each item to show that the goods were actually received and checked. After a receipt is given and the freight is piled in the warehouse and at time of loading, the shipment should be again checked into the car, thus verifying the receiver's check. The shipping order then goes to the bill clerk, who must use care and show each item on his waybill as it is shown on the shipping order, using correct weights and rates to avoid claims for overcharges.

At local stations we have the agent check his freight out of the car while the train crew unloads, and the conductor checks freight into the car while the agent and motorman load. If a shortage exists, both conductor and agent make reports. The agent should at once make out his expense bills and notify consignee promptly by telephone or post card of the arrival of his goods.

We are using three kinds of expense bills, two, three and four-way. The first is used only at stations where the agent is also the warehouseman, or in other words, a one-man station. The three-way is used where a teaming company draws freight, one copy being retained by the cashier, one going to the warehouse and the third to the teaming company. The last, or four-way, is used only in Grand Rapids where a collector is employed, the extra piece being for use of the collector.

Overs, Shorts and Damages

It is very important that agents and conductors make reports promptly on short, over and damaged freight. We have a system whereby overs, shorts and damages are numbered, booked and checked on tissue copies of waybills in the auditor's office, and all investigation made with this report so that when a claim is presented we have all informa-

tion at hand to make prompt settlement, which is very gratifying to claimant and is a business-getter.

Claims

When a shipper presents a claim properly supported by paid expense bill, shipping bill and original or certified copy of invoice, receipt of the papers should be acknowledged, giving him your claim number.

Claims are an important item in handling freight traffic and can be kept down to a very low figure if agents and train crews take proper precaution in handling and checking freight in their charge. Claims for loss are sometimes very mysterious, the records at the forwarding station indicating very plainly that the shipment was properly loaded, the car went through to destination and part of shipment was checked short—no change of cars en route. This can be properly laid to improper marking or wrong delivery.

Damage claims when freight is of a nature to be seen, and reports of conductors and agents verify, are more satisfactory to pay. Some transportation companies offer to compromise on concealed damage claims on a 50 per cent. basis, claiming damages may have occurred while freight was being drawn to or from the station. It generally makes claimants angry; sometimes they will settle and sometimes they will not. A good man at the receiving door, if a shipment is offered which has the appearance of being damaged or is rattling, should investigate before giving a receipt.

Prompt payment of claims is a great aid to a solicitor, and some steam lines allow their agents to pay all claims of $5 and under if their judgment deems such a claim just. I do not think I would recommend such practice for an interurban, for the reasons that it does not take long to get the information as to damages, under or overcharges, and there are not nearly as many claims handled as on a steam line; nevertheless, claims should have prompt attention.

Another important part in the handling of freight is clear receipts for goods at destination and date of delivery. Our agents at local stations are not allowed to extend credit to anyone, and it is the duty of the traveling auditor to see if their receipts are properly signed and dated.

We have adopted the card system in handling claims; each claim is given a number and a card is made out representing the claim and showing where the papers are sent; at least every 30 days we send a tracer after the papers. At the present time we have 68 unpaid claims, and only ten over one year old; this road has been in operation seven years.

Revenue

In looking over our statements for 1908, I find the following figures: Average receipts per freight car-mile, 43 cents, for which the cost of handling was 51 per cent. of the gross freight earnings. We have nine freight cars of 30,000 and 40,000 lb capacity.

The items charged to cost of handling freight are power, maintenance of equipment, wages of conductors and motormen, wages of station employes, whose services are required for handling freight, rent of tracks and terminals, rent of land and buildings, freight damages, printing and stationery.

We have a monthly statement showing exactly our revenue from freight and expense of handling it.

Accounting

We have a regular steam road form of waybill; our shipping bills are those adopted by the Interstate Commerce Commission. After the bill clerk makes his way bill it is copied in a tissue book and accompanies the freight to destination. The receiving agent gives each consignment a different pro number and enters the expense bills in his cash book; the waybill, after freight is unloaded and checked, is pasted in what we term a waybill paster, which is really a freight received book, carrying totals of weight, freight, advances, and prepaid at the bottom of the page so that the agent, at any time, by taking his last current month's debits, can deduct his outstanding balance.

We have tissue copies of all waybills sent to the auditor in order that overs, shorts, damages and claims may be checked thereon.

At the end of the month the agent abstracts his forwarded and received way bills and makes out his balance sheet, which is checked by the traveling auditor and a correction balance issued, if any errors are found; if no errors are found he is given a clear sheet. If an error is found in the previous month's bills the agent asks for station relief, and is not allowed to accept corrections after his monthly reports have gone to the audit office.

The foregoing is an abstract of a paper read before the American Street & Interurban Railway Transportation & Traffic Association, Denver, Colo., Oct. 6, 1909.

DISCUSSION ON PAPER 301—REPORT OF THE COMMITTEE ON WAY MATTERS

To the American Street & Interurban Railway Engineering Association:

Your committee on way matters has presented an interesting and valued report and it is hoped that the discussion will result in some action in recognition of advantages and adaptability of the use of T-rails in paved streets and for all classes of traffic conditions.

The companies and cities that have had the greatest experience with the use of T-rails in paved streets are the strongest advocates, and therefore their opinions must have the most weight. The question of the proper dimensions and type of rail has been heretofore so dependent on the types and kinds of paving that the two questions should be considered together, and as the question of economical maintenance is acknowledged by the committee of such serious importance it would seem most proper to consider the matter of economical maintenance concurrently with the question of the selection of the proper rail and paving.

Let us first consider briefly the question of paving.

Heretofore the belief of the necessity of granite block paving where heavy vehicular traffic occurs has dictated the use of a high rail, but to-day where a concrete paving base is used, it is acknowledged that a smooth type of paving surface is preferable to a granite block and this is equally true for both the railway company and the city.

Granite block paving is generally more expensive, is noisy, retains water in joints, and on the authority of the late Col. Waring, the greater cost of keeping clean such rough pavements would pay the interest and depreciation on the total cost of smooth surface pavements.

If we discard the general use of granite pavements and consider the question of types of rails and maintenance costs where modern pavements are used on a concrete base, we immediately find that the principal argument in favor of the use of a grooved or flanged section of girder rail disappears. It is quite safe to assume that if we had not started with the use of granite block paving we would now be using a very much greater percentage of T-rails in paved streets.

Where a suitable concrete base is used for both track and paving foundations, there is no difficulty in connection with the use of a standard section of T-rail, and if properly designed and constructed the pavement should not wear in ruts. T-rails present much less metal on the street surface and therefore are better for street traffic, and can be made satisfactory for all classes of street traffic by adoption of the proper type of paving. It is inadvisable to pave between the rails and the narrow strip outside where the balance of the street is unpaved, the cost of maintenance is always greater than in a fully-paved street, it encourages vehicular traffic on the tracks causing delays to cars, and it should not be difficult to convince the city authorities

of the bad practice of paving tracks when the remainder of the street is unpaved.

Regarding the type and size of the rail every encouragement should be given to eliminate and abandon the very large number of different sections that have been designed and heretofore used. There seems no good reason why the girder rail cannot be reduced to not more than two sections (with corresponding section of guard-rail) and to adopt the standard section of T-rail—of varying weights—with perhaps one section of high T-rail.

The height and weight of the rail should be selected with regard to the weight and class of cars to be operated and to-day the many interurban cars running over the city tracks and the noticeable general adoption of larger cars for the city service, there is not the great difference in the cars operated on the various city lines as formerly and therefore in most cases, one height and weight of rail could advisedly be adopted, but in no cases are more than two heights or sections necessary. The question of frequency of car service should not be the governing factor in the selection of rail section for in designing a bridge you consider the load to be carried and not the frequency of trains—but in designing your foundation, joints and special work you must consider frequency of service in reference to cost of maintenance.

Where it is now compulsory to use granite block paving, the track should be of high T-rail—but it is strongly recommended to discard granite block paving wherever it is possible to do so.

Companies now using the flange-tread type of girder rail would find that T-rail would be cheaper and more satisfactory, and the street traffic would not produce ruts along the rails if modern smooth paving on concrete base was used.

Where girder rail is demanded by city authorities, it is generally due to lack of appreciation of the advantages of the T-rail and of the practicability of paving up to the top of the rail. In every case that has come under my observation and experience, T-rail has been locally acknowledged as very much quieter, and its only objection is an assumed one of difficulty in paving up to a uniform surface, which does not exist in fact where pavements are properly laid on a suitable concrete base.

As to the necessity of advisability of using a high section of T-rail instead of the standard T-rail section, it should be settled by the question of the most economical design for strength considering weight of metal, other things being equal, therefore when satisfactory paving can be secured with use of standard T-rail, which can be done with rails weighing 90 lb. and over, this type should be adopted, being cheaper in construction and maintenance.

The open track construction used on interurban roads and steam roads should be designed for a certain amount of flexibility and cushioning effect, but tracks in paved streets should be built for solidity and to prevent movement of the rails or of the paving, and therefore a proper foundation is a large factor in reducing the cost of maintenance; a flexible track will quickly admit water between the paving blocks or between the rails and the paving, thus introducing a quick factor of depreciation and repair work.

The use of macadam pavement is generally expensive in maintenance where there is any considerable traffic, and it is not advisable in cities of over 50,000 population in streets having car tracks.

In Adelaide, Australia, the city records showed that macadam to the depth of 72 in. had been used in the maintenance of one of the principal streets during 10 years; tney afterwards adopted tar-macadam which gave a much longer life and not one-quarter the cost of maintenance.

In Manila on residential streets where macadam is used, the cost of maintenance exceeds that of maintaining hard wood block paving laid on concrete in streets having far greater traffic.

In England and on the Continent, also in New Zealand and in Manila, where girder rails have been laid in concrete with the use of cross-Ts 8 ft. to 10 ft. apart, it was found necessary and advisable to anchor down the track by the use of short pieces of the same section of girder rail riveted or bolted to the under side of the bottom flange at the joints, and at points midway, these anchors were buried in concrete which was also carried 2 in. over the base of rails. Without these anchors, the track would sometimes lift itself and break and crack the ordinary grouting over the rail base.

In Shanghai one section of the electric tramway was built without cross-ties, using girder rails and tie rods laid directly on crush-rock and filled to top of rail and rolled as macadam, no concrete was used; after two years it is now in bad line and surface as might have been expected.

Re The Use of Open-Hearth Steel Rails

You may be interested to know that the Chinese, after studying steel rail mills, have adopted the open-hearth process in their large steel plants operating at Hanyang, about 600 miles up the Yang-Tse above Shanghai.

To-day they are turning out a very good quality of open-hearth steel rails. They are rolling on 85-lb. English section for use on some of the steam railroads now building in China, but they have promised to adopt the American standard section as soon as templates can be furnished to them, which will be desirable, as by their present capacity they cannot produce the tonnage required for roads now under way. There are no electric railways now building in China.

In closing my remarks I desire to thank the committee for the extremely good work they have accomplished in their efforts to improve and standardize construction.

Respectfully submitted,

C. G. YOUNG.

EMPLOYEES' PAPER IN BERLIN

The employees' society of the Berlin (Germany) street railway system has been publishing successfully for the last eight years a fortnightly paper known as "Die Strassenbahn." This is the official organ of both the society and the Grosse Berliner Strassenbahn. Each issue is published as a form of 16 pages with one extra loose sheet of the same size on which are printed the official announcements of the company. The reading matter is of the most practical kind for both railway and family purposes as may be noted from the following titles in one number: Observations on the Behavior of Railway Men on the Witness Stand, by a Claim Agent; Private Insurance versus Society Insurance; The Society's Provisions for a Vacation Colony; How Can Conductors Keep Their Hands Clean During Service Hours?; Care of Children During the First Year; Scope of the Free Legal Aid Privilege; Summer Diseases, and Directions for Bathing.

The paper is free to all members of the society. The publication expenses are paid by the advertisements and a small annual subsidy from the company. All the advertisements refer to articles which are likely to be used by railway men and their families as no effort is made to secure complimentary announcements from the makers of electric railway equipment. An important branch of the society's activities as chronicled in this journal is the arrangement with various business and amusement enterprises to give certain discounts to members of the associations. It appears also from a recent issue that the company has made arrangements with cafés near the terminals of runs for the free use of their toilet facilities by railway employees. This consideration for their interests is greatly appreciated by the men as it saves them from spending money for drinks, tips and the like.

COMMUNICATION OF F. T. FULLER, VICE-PRESIDENT PORTLAND RAILWAY, LIGHT & POWER COMPANY

In discussing the tentative rules prepared by your committee it should be first stated that as prepared they show evidence of much thought and study and cover the ground generally in a very thorough and satisfactory manner.

In considering a set of rules which would be applicable to all city roads a great many points which could and should be included in the rules for a particular company must be omitted. At the same time a number of rules would naturally be included which would not be applicable to some special locations. For the above reason it seems to the writer that such rules can only be used as a basis for those of a particular company and that it will be practically impossible to obtain a set of rules which can be printed and used for all portions of the country. If this were attempted it would result in the number of bulletins issued outside of the printed rules being very large, when the better plan would be to incorporate them in the regular rules of the particular system.

To illustrate these points, I would say that the matter of restricting the conductors to making change for a sum not exceeding $2.00, while applicable to most of the country, would not apply at all to the Pacific Coast, where there are few bills in circulation. With us the coin next to a dollar which would be presented to the conductor would be a $5.00 gold piece. On our particular system we do not limit the conductors in the matter of making change at all.

As another illustration, on our system in Portland we operate across four separate draw bridges and it has seemed wise to make the rules relating to operation over these bridges a part of our regular rules rather than to issue bulletins covering the same. Also, the ordinances of our city provide that every street car shall come to a dead stop before crossing any other street railway track, and our rules regarding this compulsory stop and the giving of signals for starting are incorporated, of course, in our main set of rules.

Commenting upon the rules as drawn, from the standpoint of our conditions on the Pacific Coast, there is one point to which we should like to call special attention. The rules drawn are very concise and to the point, but there is little in the way of explanation or appeal to the men and no special reference is made toward the men working hand in hand with the management for the reputation and interests of the company. In dealing with the high class of men that we have been able to get in our city on the coast we have deemed it fair and wise to incorporate a few ideas of this nature in our rules. This can be illustrated by comparing the general notice of the tentative rules and the following extract from our general introductory notice to the rules:

The safety of passengers and of others on or about the cars is of the first importance, and all work on the road, including operation, repairs, or construction, must be subservient thereto. To this, with the regularity of the service, and the comfort and convenience of the passengers, all work must be entirely subordinate.

All employees are required to be polite and considerate in their intercourse with the public. The reputation and prosperity of a company depends largely upon the promptness with which its business is conducted, and the manner in which its patrons are treated by its employees.

For the effective operation of a street railway system the close observance of rules and the maintenance of strict and impartial discipline are necessary. The fact that any one enters or remains in the service of this company will be considered as an assurance of his willingness to obey its rules, render faithful service, and be loyal to its interests.

The ground covered is very much the same, but it seems to us that the effect upon an employee of reading the two notices would be entirely different. It may be that this different presentation would not be of any advantage in some cities, but we are satisfied in the past on the roads with which the writer has been connected, running from 100 to 1,000 platform men, that this idea of suggesting the co-operation of the car men with the company by numerous explanations and suggestions through the rules, followed by special efforts to accomplish this co-operation in practice has proved of great benefit to all concerned.

To further illustrate this point, under the head of "Prevention of Accidents," we close with:

Vigilance, the exercise of good judgment, avoiding risks, and a strict compliance with the rules and orders will materially aid in the prevention of accidents.

And under the head of "Looking out for Passengers" we close with:

The business of the company is to carry passengers and conductors are expected to use their best judgment and the utmost vigilance to the end that as many passengers may be carried as possible.

And under the head of "Lost Articles" it is stated that such articles remaining unclaimed after 30 days will be returned to the car man finding the same, all following the same idea that the employer and employees are expected to work together for their mutual benefit and the benefit of the public.

The following remarks and suggestions in regard to the tentative rules reported are made, not as criticisms, but as the result of experience in the operation of street railways on the Pacific Slope and what would seem advisable there. Whether any of the suggested changes would prove advantageous generally or in other sections would be best determined by those operating in such sections.

As a general principle it should be said that rules should be as simple as possible and be arranged in such a manner as to read from one subject to another as they would naturally occur to an employee, as for instance, the matter of appointment should come first. Knowledge of rules and report for work would perhaps follow in order.

In the tentative rules nothing is said about appointment. It is perhaps a question whether this subject should be explained in the application or in the rules, but as a copy of the rules and regulations are usually given a new man breaking in or receiving instructions, this has been the subject of our rule 1, which is as follows:

All car men are required to break in until fully capable of performing their duties in a thoroughly safe and efficient manner and when turned in will serve for 30 days on trial. If at the end of that period their services are satisfactory they will be placed on the list of employees. They will work as extras until for any reason they are advanced on the list to a regular run.

Our rules also include general rules pertaining to reporting for work, penalties for failure to report, laying off, and rules relating to uniforms and badges. While the matter of reporting and laying off would perhaps vary on different roads to such an extent as to render it impossible to prepare a set of rules which would be general in these matters, there would apparently be no question but that some rules regarding the wearing of uniform, caps and badges could be made general, somewhat as follows:

All car men after being placed on the list will wear a uniform, including cap, badge and company buttons while on duty and maintain a clean and neat appearance appropriate to their occupation. (Then follows a description of standard uniform, cap and location of badge, etc.)

No car man will be allowed to take his car without his badge, which must be worn on the front of the cap. Under no circumstances will any employee lend his badge to any person. The loss of a badge or register key must be at once reported to the superintendent or inspector.

Under Rule 5, "Habits and Personal Conduct," our experience suggests the inclusion among the prohibited acts, that expectorating tobacco juice on any part of the car would not be allowed.

Under "Accidents" there is no special rule or paragraph for the prevention of the same. We cover this with the following among other items covered by the tentative rules in various places:

To prevent accidents, request passengers to alight on the side nearest the sidewalk, and warn them to be aware of passing cars or vehicles. Caution passengers not to get off the car while in motion. Prevent ladies and children from doing so by placing your arm across the platform and grasping the rail next to the car, at the same time politely say: Wait until the car stops.

Small children must not be allowed to ride on the front platform, unless in charge of some grown person.

Children must not be allowed to take hold of a car to run, or ride bicycle beside it.

In the event of any immediate danger to the public caused by any of the company's apparatus such as breakage of over-head lines, holes in the street, bridges, etc., the first employee discovering same must arrange first to protect the danger point, and then notify the proper authorities by the first available means of the character and location of the trouble.

When the trolley leaves the wire the motorman will immediately throw off the current and stop as quickly as good judgment will permit, so that the pole will not strike the span wires or arms.

Never run down any grade without the trolley on the wire.

Under the rules for motormen we would suggest the incorporating of a rule regarding vestibules and curtains about as follows:

If for any reason motorman cannot get a clear view of the track ahead through the glass front of the vestibule he must open the front window until such time as it is safe to run with it closed. This is especially necessary at dangerous points, such as railway crossings, draw bridges, etc. Curtains between the front vestibule and the body of the car must always be drawn down after night fall. Never run with the rear curtains drawn down.

Also in regard to "Speed":

(a) Motormen must use good judgment in the matter of speed, and always tend to be over-cautious rather than a little reckless.

(b) Safety of life and property is the first thing to be considered. The running time is such as to be made without taking chances; but if from any special conditions it is impossible to make it safely the time will be a secondary consideration.

(c) They must conform to time table requirements as closely as possible, regulating speed in accordance therewith and with the limits of the time points. If a motorman should be delayed he will not undertake to recover the time lost in the minimum distance, but if it is entirely safe to do so he will run slightly faster, aiming to reach destination or end of trip as nearly on time as may be possible.

Also in regard to "Headway":

(a) When one car is following another under ordinary running conditions, the rear car shall keep at least 260 ft., or one block, clear of the car ahead, and when on grades great care must be used even at this distance.

(b) When regular running conditions cannot exist, as at transfer points, railway crossings, business centers and crowded streets, then this space can be reduced with the exercise of great caution on the part of the motorman. There is no excuse for a rear end collision.

Also in regard to "Right of Way," after a long list of rules we close with the general statement:

It must be distinctly understood that the right of way does not in any case mean that you have a clear track, the right to cross regardless of anything, neither does it do away with the rule for stopping at railway crossings or justify a collision with the car ahead.

Under the rules for conductors would suggest the addition of rules regarding the matters of ventilation and heating of the cars, something as follows:

(a) Conductors will have charge of the heating switches in the cars. They will turn on these only when necessary for the comfort of passengers, using the half or only one side of the car as much as possible. In a crowded car it is rarely necessary to have the heaters turned on.

(b) When the power is weak and travel is heavy, the current must not be turned on the heaters at all.

(c) When turning a car into the barn at any time conductors must make sure that the heaters are turned off.

Conductors will open or close the ventilators as required for the health and comfort of passengers, especially in crowded cars.

As an addition to Rule 10, "Signals," it has been found that five rings on the gong by the motorman as a signal to another car at a transfer point that he has passengers to transfer has been of great benefit.

Rule 21, "Standing on Steps," is a rule which in practice we have found impossible to enforce, as during the rush hours or crowded traffic persons will stand on the steps. It should be left out or qualified.

Under Rule 117, "Change," we suggest the addition "That conductors must never allow themselves to be without change," and "That they must know the amount of their own cash at all times."

In Rule 202, second paragraph, we suggest a change so as to read: "Cars must be run slowly and with great care in the vicinity of schools or any place where there are children on the street."

Rule 205. We have been unable to see the necessity for this rule.

Rule 210 makes it obligatory to use the emergency stop, that is what is called slugging of the motors, as the first step in case the brakes do not work. This act is one which cannot always be depended upon, and is, therefore, the last step to be taken under our rules after everything else has been tried, including reversing of the car. We have found many cars in which this emergency stop either fails to work entirely or is very unreliable, and after close inspection have not been able to locate the trouble. This applies only to two-motor cars, as we have never yet tried four-motor equipment on which the emergency would not work. We, therefore, consider it safer in case the car is beyond control, either going forward or backward to try to hold it with the power than to rely on the emergency. If they fail to stop a car with the power then try the emergency.

Rule 220 we think should be a little more explicit, so as to refer particularly to controllers. We can see how there might be some cases in which, if a car man was allowed to oil his trolley, or possibly a brake staff, it would be a decided benefit, especially on long runs.

Without going into details would say that detail rules on the following subjects have been found necessary with us:

Special Reports.
Running on Time.
Backing Cars.
Assisting Conductors.
Obstruction on Track.
Missing Fares.

There are many other points that might be brought up, but ideas as to rules are like ideas as to building of houses, they are of infinite variety, and while there can be no absolutely standard code of rules any more than there can be a standard house, yet the knowledge of each code helps in the preparation of a code for the particular conditions to be met.

The writer is a firm believer in making rules and bulletins as simple as possible in language, but full and explicit, as it does seem as if every order, however carefully drawn, will be misinterpreted by some one.

In going over the tentative rules we have found many points better covered than by our own rules and when it comes to a revision with us many of the tentative rules will be incorporated in ours.

Our company has been greatly indebted to this association for the standard rules previously prepared by them, which indebtedness we now acknowledge has been increased through the work of your committee.

The Denver Gas & Electric Company is one of the most enterprising public-service companies in the country. One of its stunts is an anual canvass of vacant houses. A report just issued shows that in September, 1909, there were 1479 vacant houses in Denver, which is 30 per cent less than the number reported last year.

The city of Denver was founded in 1858. The first horse car was run in 1871.

REPORT OF THE COMMITTEE ON POWER GENERATION*

By G. H. Kelsay, Chairman; W. S. Twining, A. S. Byrd, William Roberts, James D. Andrew and Fred Heckler

The committee investigated the following subjects: (a) Flue Gas Analyzers: (b) Steam Meters, and (c) Low-Pressure turbines. Meetings of the committee were held in Pittsburg on May 11, and in Philadelphia on July 19 and 20. Some very valuable information on the subject of low-pressure turbines is furnished by one member of the committee from his personal experience with one of the first low-pressure turbine installations made in this country.

(a) Flue Gas Analyzers

Your committee continued the investigation of this subject this year because last year's work indicated that a great deal of uncertainty existed as to the real merits of the CO_2 flue gas analyzer. The investigation showed that there were but few railway power-plant engineers who had attempted to make flue gas analysis, particularly with the automatic recorder.

Replies to inquiries sent to member companies this year recorded but 23 users of gas analyzers, this being an increase of only nine over last year's figures.

The practice of analyzing flue gases as a part of the regular routine in conducting boiler tests has been the rule with engineers for some time, and is prescribed in the code of the American Society of Mechanical Engineers for conducting such tests. In this code the determination of CO_2, CO and O is provided for, and the benefit that comes from such determination in all boiler tests is unquestioned, but the committee has endeavored to determine what value, for the purpose of developing and maintaining higher boiler efficiency, there may be in the practice of making either intermittent quantitative analyses of flue gases by the Orsat apparatus or continuous analyses with the CO_2 recorder.

The very thorough and valuable work which has been conducted for the past four years by the fuel-testing plant of the United States Geological Survey has had as one of its many subjects under investigation "the condition under which different coals may be most economically burned," and their work has stimulated greater interest in the subject.

For this reason any auxiliary device for aiding the proper handling of the furnace has been received with considerable enthusiasm by most engineers. Unfortunately, however, the advantages in economy to be realized by analysis of flue gases in the average plant have been largely overestimated, as replies received from engineers to inquiries sent out will verify.

Flue gas analyzers and CO_2 recording instruments and their value in the boiler room have, to a very great extent, been overdrawn by their agents. It is our opinion that a lack of progress and a great deal of discouragement have resulted on account of the average power-plant engineer expecting too much with too little effort in the use of such devices.

A large portion of the literature that has been distributed by the manufacturers of gas analyzers has contained too little of the real results and facts that may be obtained by the average engineer with the application of the gas analyzer in his plant.

Last year the committee thought it essential to publish in full practically all the replies as received from inquiries sent out at that time. Some of the questions asked this year were the same as asked a year ago. The replies to the most essential questions as submitted to member companies this year have been of such a varied nature that, in the opinion of the committee, they cannot be used to advantage.

From the results of last year's investigation, in one reply only was the opinion expressed that a record of other gases than CO_2 was desirable as far as ordinary operation was concerned, whereas, replies to the same question this year indicate that 13 of the 23 roads replying analyze their gases for other than CO_2, two of them regarding it an advantage and eight replying that they do not. The replies to the question therefore indicate that there has been considerable change of idea on this one important point.

Corrective Effects

It is conclusively shown from the many replies received that the efforts of engineers to make flue gas analyses have caused many investigations into the actual conditions existing in boiler rooms, resulting in much closer attention to methods of firing and a correction of many defects in boiler and furnace settings. Possibly the most noticeable change in this connection has been a general reduction in excess air admitted to the furnace by infiltration through boiler settings.

One of the companies to which the committee sent its questions, and which has had but little success with its CO_2 recorders, suggests a method of flue gas analysis in connection with evaporative tests that has proven quite successful. This method is as follows:

A large sampling bottle is attached to the flue at the point where the gases leave the boiler setting. The siphon of this bottle is so regulated that the filling of the bottle will require the full time of the test. Another sampling pipe is inserted over the bridge wall, and to this is attached the regular Orsat apparatus. Frequent samples are taken and analyzed during the test, care being taken to note the conditions of fire, draft, etc., and method of stoking, also evaporative results at time of taking samples. A comparison of these analyses and notes has proven of great benefit in improving methods of stoking, and a comparison of their average with the analysis of the continuous sample taken at the rear of the boiler gives a definite check on air leaks in the setting.

From the replies received this year it appears that opinion is divided upon the question of what benefit is to be derived from the practice of making flue gas analysis. Although a great many of the replies were quite full, and undoubtedly represented considerable attention on the part of the authors, the committee feels that, on account of the division of opinion, it cannot present definite conclusions, and thinks that the subject should be referred to next year's committee for further investigation, possibly to the extent of causing experiments to be conducted along definite lines.

(b) Steam Meters

This subject was before the committee last year. At that time it was found that there was but very little information of a reliable nature to be obtained. This year's investigation shows that there is quite an interest in the subject, and that many engineers are looking for a meter that is reliable for measuring steam when supplied to turbines or engines.

Last year's report was principally based on the description of the theory of the operation of various meters on the market and a tabulation of replies to inquiries furnished by 20 industrial concerns from whom considerable information was obtained. The data collected last year was of little value in showing the application of the steam meter in measuring steam supplied to the turbine and engine units. Therefore very diligent effort was made this year to obtain information from users of meters supplying steam to this class of service.

Manufacturers of steam meters state that there have been

*Abstract of report read before the American Street & Interurban Railway Engineering Association, Denver, Colo., Oct. 4, 5, 6, 7 and 8, 1909.

very few meters sold of 6-in. size or larger. Their principal difficulty in handling a unit of large size is their lack of facilities for calibrating it. Most meters that have been supplied in the past require individual calibration. The manufacturers have experienced great difficulty in making them operate accurately, because of the superheat and the presence of pulsations in the supply.

There have been two well-conducted attempts made in the past few months to make use of steam meters, the results of which have been freely given to the committee.

One case was the application of a steam meter to a 1000-kw low-pressure turbine. In this particular application it was found that, owing to the very unsteady flow of steam, the meter was unable to measure it accurately, and the results were so unsatisfactory that the meter was taken out.

In the second application the meter was installed for the purpose of measuring steam used for operating air compressors. This was a 3-in. meter, and the conditions under which it had to operate were very unfavorable, inasmuch as the quantity of steam taken by the air compressors was only a small percentage of the indicating capacity of the meter. The results of this test, however, which was very carefully conducted, demonstrated that the meter was quite satisfactory, and indicated that if it had been operating near its capacity the results would have been entirely satisfactory.

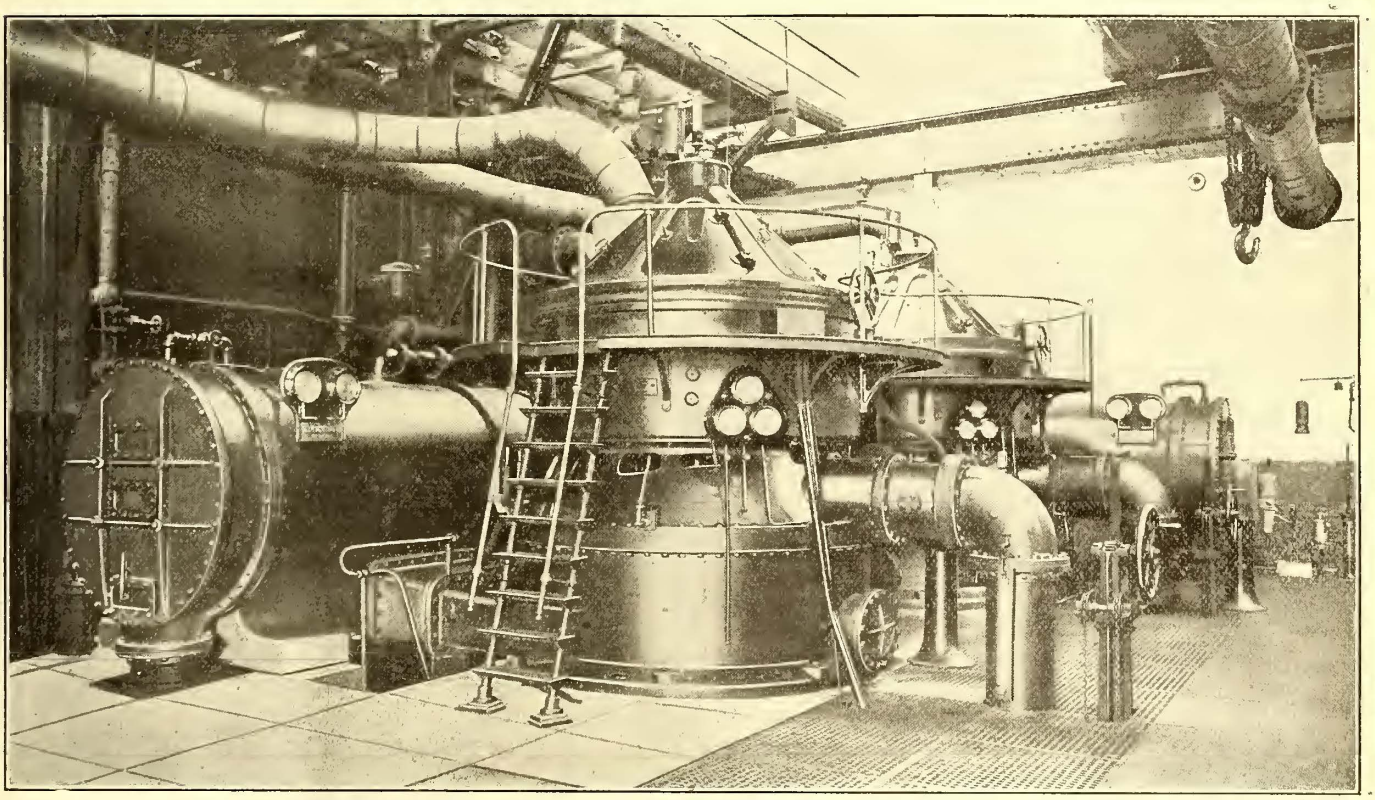
Such information as the committee has been able to obtain shows quite conclusively that the steam meter has not yet been developed to the point at which it may be said to be entirely satisfactory for measuring accurately the quantities of steam supplied to large units where the steam is superheated or of intermittent flow.

(c) Operating Features of Low-Pressure Turbine Plants

The first installation in this country of turbines operated by low pressure or exhaust steam took place about four years ago, and the operating results of these first installations have been carefully followed by engineers interested in improving the economy of existing plants. Three years' operation has demonstrated that the exhaust or low-pressure turbine has fulfilled very largely the expectations of the manufacturers and designers, and the past year has witnessed a number of installations, the most important being the large machines installed in the Fifty-ninth Street power house of the Interborough Rapid Transit Company of New York, to which reference is made later.

Your committee has investigated and obtained information as far as possible regarding all the installations that have been made up to the present time. Some of these plants, however, have been installed so recently that valuable operating data or tests are not available.

The low-pressure or exhaust turbine is an adjunct to the reciprocating engine, and performs the function of utilizing the expansion of the steam between the limits of 15 or 16 pounds absolute and one pound absolute. Since initial pressure for this type of apparatus is practically atmospheric, it is, of course, understood that the low-pressure turbine must be operated with a condenser, and that the higher the degree of vacuum that can be maintained on this machine (other things being equal) the greater the economy that may be expected from the unit. Reciprocating engines, on account of the enormous size of the cylinders required, do not lend themselves readily to large ratios of expansion. On the other hand, the turbine is particularly well adapted for handling the large volumes of steam which result from high ratios of expansion. This ability to handle the large volumes that result from the higher degrees of vacuum is one prominent characteristic of this type of machine, and the fuel saving obtained is the direct result of its utilization. The mechanical efficiency of these machines is also high, and the labor account for operating them has been found to be remarkably small.



Power Generation—Low Pressure Tur bines in Philadelphia Rapid Transit Plant

Your committee finds that these low-pressure turbines are being installed in two classes of plants:

(1.) In plants where the reciprocating engines have been operated for some years non-condensing, usually through lack of a sufficient water supply. In most cases these are plants which have been built for some years, and the exhaust turbine when used with cooling towers and condensers has proved a satisfactory means of increasing the output of the plant and improving the general economy of the station.

(2.) In connection with plants which originally were designed and operated with condensing reciprocating engines. In this case a large increase in output has been readily obtained, but the increase in economy is not so marked.

The earlier turbines which were installed in plants first noted above, were all connected to d. c. generators and were, therefore, of comparatively small size. The largest machines of this type that have been successfully operated are about 800 kw. The use of the low-pressure turbine, coupled with a.c. generators and operating in parallel with other machinery of the same class, has led to the building of these machines in much larger sizes within the last year, and one machine of 7000 kw is now in operation, and the manufacturers report that others are on order. Where the machine operates in parallel with other generators in the same plant, and is electrically interlocked, a safety governor alone is necessary, and the output of the low-pressure turbine is directly in proportion to the amount of steam coming to it from the other engines in the plant.

In this connection it may be stated that the turbine may be either piped directly to one engine so as to form, as it were, an additional cylinder for the unit, or it may receive its supply from a header or main into which all the engines about the plant exhaust.

For either "header system" or individual installation, the intermediate pressure between the engine and turbine may be allowed to vary with the load, or else be maintained constant, depending upon the conditions which obtain in each installation. There is considerable advantage in having the intermediate pressure fluctuate with the load, particularly on light loads. Here the back pressure on the engines would be reduced and their economy held up noticeably, while the turbine economy would not be materially affected over that of constant pressure supply. In this way the overall results of the combination may be greatly improved. The main abject in maintaining a constant exhaust pressure is to avoid air leakage where the pipe joints or the rod and gland packing on the engines are not sufficiently air tight. If allowed to fluctuate there would be air leakage when the pressure was below atmospheric, thus reducing the vacuum. Such leakage would occur only on light loads, and the air-pump capacity being then in excess of the needs is better able to care for the greater air leakage. Inquiries sent to the users of low-pressure turbines, elicited the information that no trouble was experienced from air leakage where the exhaust pressure varied with the load and fell below atmospheric pressure.

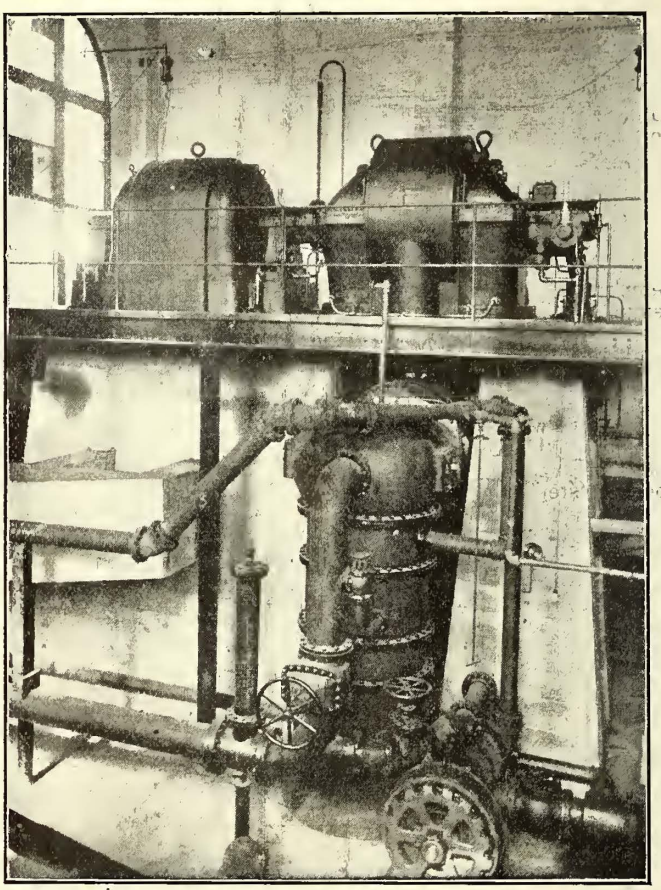
A modification of the low-pressure turbine, known as the mixed-pressure turbine, may be noted. In this type of machine provision is made for the use of live steam whenever the supply of exhaust steam is not sufficient to take care of the demands upon the electrical end of the machine. The addition of this feature, of course, will increase the cost considerably and is only warranted in special cases.

It is characteristic of these machines when operated with only a safety governor that with a fixed pressure in the supply pipe the load carried will be a fixed and predetermined amount. With a variable pressure in the supply pipe the load carried by the turbine will rise as the load rises on the reciprocating engine, since the increased output of the reciprocating engine increases the quantity of exhaust, and thereby raises the pressure in the supply pipe of the turbine, thus increasing its output. As stated earlier, the condenser is a very important part of a low-pressure turbine installation, and no particular type seems to have received the preference. Where the water supply for the operation of condensers is limited, and it becomes necessary to use artificial means for cooling the water, resort must be had to the use of either cooling towers, spraying ponds or other suitable means for dissipating the heat. While such devices are an absolute necessity, in many cases they tend to reduce the economy. Reports indicate that motor-driven fans when used on cooling towers will consume from 5 per cent to 8 per cent of the power of the machine, depending on the weather conditions. The total power consumed in operating condensers and cooling towers apears to run from 12 per cent to 18 per cent of the power generated.

Since the turbines should be supplied with clean, dry steam, an efficient oil and drip separator between the reciprocating engines and the turbine is considered to be an absolute necessity. An advantage arising from the use of this oil separator will be found in plants using surface condensers, since the condensed water being free from oil can be used for the boiler supply, and this greatly minimizes the amount of scale in the boilers.

Costs

Your committee has been able to obtain only fragmentary information as to the cost of low-pressure turbines and their installation. When installed as an adjunct to an old plant, as has been the case in most instances, the changes of piping and general alterations of the plant often involve a very considerable expenditure. The turbine will range in cost, say, from $35 to $40 per kw in the smaller sizes to from $15 to $18 per kw in the larger sizes, which, of course, in that case are understood to be a.c. generators. The complete installation, however, including all the auxiliary machinery, condensers, cooling towers, etc., if necessary, and including changes in building and piping, may run the cost up to from $80 to $100 per kw in the smaller sizes, although $40 to $50 would doubtless cover the entire expense in the larger sizes.



Power Generation—Low Pressure Turbine with Condenser and Ventilation Ducts

The replies received by your committee from users of turbines indicate that exhaustive tests of economy are not available.

It should be noted in connection with the following statistics of the Philadelphia Rapid Transit plant that during the greater portion of the day the turbines utilize only a fraction of the exhaust steam furnished by the reciprocating engines. In this plant the main exhaust pipe is open

to the atmosphere and the initial pressure is principally atmospheric. An abstract of the results is appended herewith.

Operating Statistics of Low-Pressure Turbines of Philadelphia Rapid Transit Company

800 kw Curtis exhaust steam turbine d. c.	
Duration, 8 hours—8:30 a. m.-5:30 p. m.	
Average load on Turbine (corrected)...	805.85 kw
Total water from turbine per hour.....	31,918 lb
Moisture in steam, 0.3 per cent.....	92 "
Water used by step-bearing per hour....	1,402 "
Net steam used by turbine (dry) per hour..	30,424 "
Steam per kw-hour (dry)	37.75 "
Steam pressure	14.53 " abs.
Barometer.....	30.16 in.
Vacuum.....	27.50 "
Absolute pressure.....	2.66 "
Temperature of exhaust steam, 2.65 in abs.....	110.8 deg. Fahr.
Swing of load.....	1,350-1,550 amp.
Power absorbed by motor-driven auxiliaries.....	158.02 e.hp.
Power absorbed by dry-vacuum pump...	9.94 hp
Power absorbed by hot-well pump.....	0.73 "
Power absorbed by step-bearing pump..	4.12 "
Total power absorbed by auxiliaries....	172.81 "
Percentage of auxiliaries to total output.	15.9 per cent
Average load on engine (8 hours).....	4,075.7 kw
Percentage of turbine to engine load....	19.77 per cent
Percentage net increased load to engine load..	16.88 "
Condenser Results	
Temperature of air, U.S. Weather Bureau	78 deg. Fahr.
Temperature of injection water.....	87.6 " "
Temperature of discharge water	98.5 " "
Temperature of hot-well water.....	109.7 " "
Total head on circulating pump.....	57.92 ft.
Total head on hot well pump.....	34.07 "
Pressure of water on step-bearing.....	189.4 lb.
Speed of circulating pump.....	545 r.p.m.
Speed of dry-vacuum pump.....	69 "
Speed of step-bearing pump.....	162 strokes per min.
Speed of turbine	1,024 r.p.m.

The relative division of the output for a 24-hr. run is: Engine, kw-hours, 84,540; exhaust turbine kw-hours, 30,150, or a ratio of 35.6 per cent.

Total kw-hours, engines and turbines, 114,690.

Turbine output in per cent of total, 26.2.

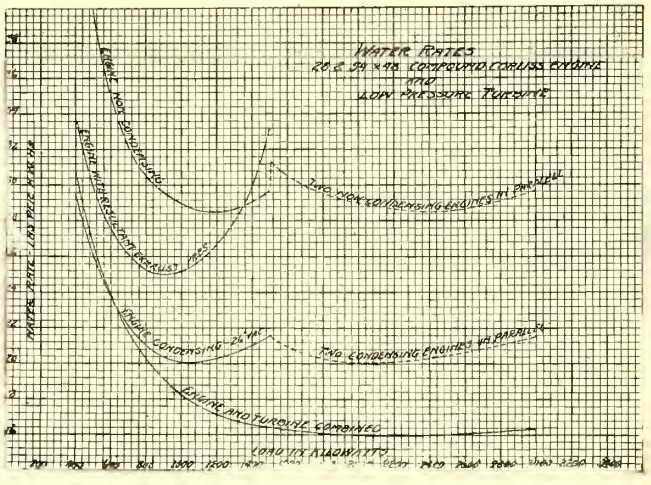
Kw-hours used by motors on pumps, condensers and cooling towers, 4436=14.7 per cent of power generated by exhaust turbines.

Net turbine output in per cent of net total, 23.3.

Appendix A—Engine Characteristics for Use with Low-Pressure Turbines

The following desirable information has been furnished the committee by a large manufacturing concern and is incorporated as an appendix to this report:

In the installation of a low-pressure turbine, particularly in condensing plants, it is necessary to operate the engine under conditions different from those for which it was designed. No difficulty should be experienced in the transformation of a simple engine from condensing to non-condensing, or vice versa, providing the proper range of valve travel can be obtained. In a compound engine the situation requires more attention. In changing over engines having a fixed ratio of high and low-pressure cylinder volumes, either from condensing to non-condensing, or operating a non-condensing engine on a fluctuating back pressure, modifications in the valve gear must be made to obviate expansion loops in the high pressure cylinder or over-compression in the low pressure cylinder, with the resulting annoying valve "pounding" and "slamming" and corresponding reduction in economy. In condensing engines of large ratio (exceeding 3¾ to 1), it is obviously necessary to reduce the back pressure on light loads to avoid looping. Therefore when the exhaust pressure varies with the load, an important feature is introduced. This applies mainly to the Corliss gear, but is true of other valves where unbalanced pressure will raise them off their seats. There is a variety of types of engines in service in railway plants, but the Corliss we believe is most generally used. As space is limited and this type will be a large factor in the combining or the engine and the low-pressure turbine, the discussion



Power Generation—Water Rate Curves for Corliss Engine and Low Pressure Turbine

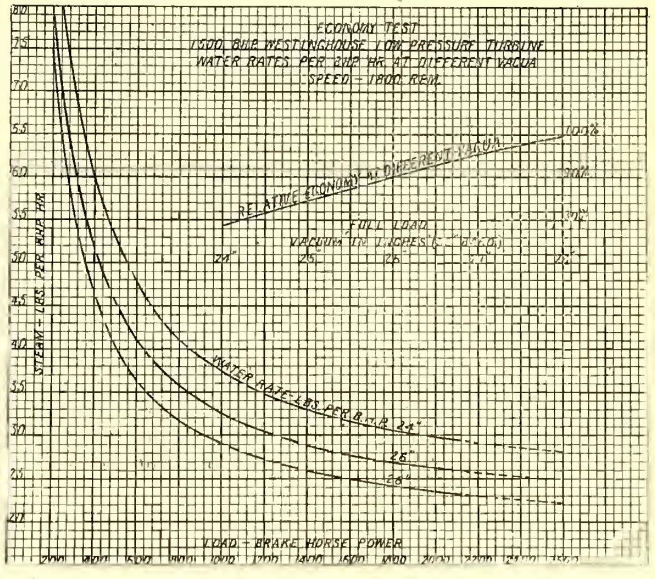
on valve gear will be confined to the features of the Corliss design. Different methods of governing compound Corliss engines may be classified principally as follows:

(1) High pressure cut-off variable; low pressure fixed.

(2) Parallel cut-off; both high and low pressure cut-off variable in the same direction, and cut-off advanced and reduced in both cylinders equally, or—

(3) Parallel cut-off with the range of travel of the high pressure cylinder greater than the low pressure cylinder; that is, proportionately.

At moderate expense these methods of governing can be



Power Generation—Economy Test Curves of 1500-hp Low Pressure Turbine

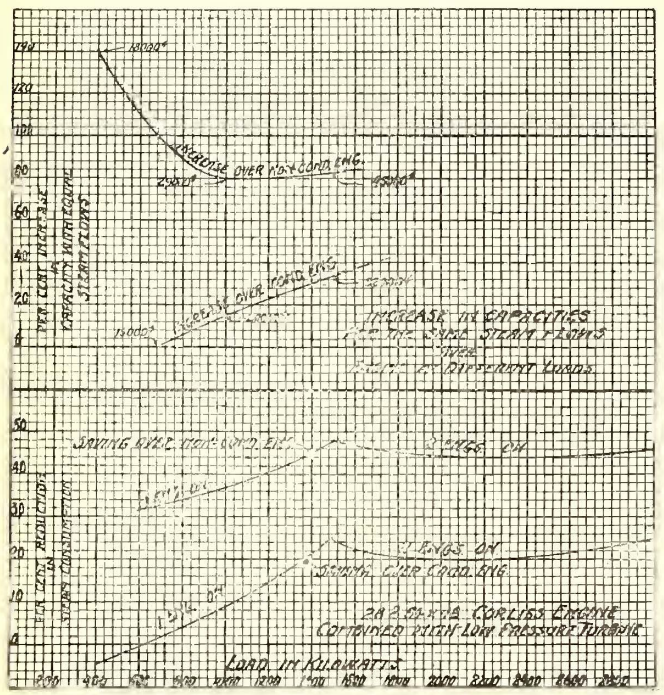
changed over from one to the other in most makes of Corliss engines. Then by careful study of the steam cycle in the two cylinders, the difficulties of looping can be anticipated, and the valve arrangement made to obviate the trouble. This can generally be done in cylinders of normal ratio for both condensing and non-condensing design. The necessity for changing the cylinder ratio can be regarded as very un-

likely. Where unusually high ratios are employed the problem in such cases becomes quite special.

It is also desirable in the contemplation of the installation of a low pressure turbine to determine approximately the clearance in the high and the low pressure cylinder in order that its effect on expansion and compression may be ascertained. As the condition of cylinder and receiver pressure may vary appreciably in making a radical change in the operation of the engine, the cylinder design and pin bearing should be properly investigated. With the advantages accruing from reduced receiver pressure on light loads the expense of providing steam packed, or double metallic packing on the low pressure rod may be warranted.

In order to double the capacity of an existing equipment by the installation of low pressure turbines, the reciprocating engine must be arranged with long range cut-off in the high pressure cylinder.

Complete expansion (i.e., expanding down to a toe, or point) in the engine cylinder, is not economical, even in connection with a low pressure turbine. A few pounds ter-



Power Generation—Curves Showing Increase in Economy and Capacity with Low-Pressure Turbines

minal drop, 2 to 4 at normal rating, non-condensing, is desirable. This not only avoids the possibility of loops at loads less than normal, but improves the engine economy and correspondingly the combined results of engine and turbine. Cylinder condensation increases with expansion, and the point can be approximately determined where any further increase in expansion is offset by increased condensation.

Results of tests of a 1500 brake hp Westinghouse low pressure turbine under varying vacuum are reproduced and show the influence of vacuum on economy. This performance is typical of the low pressure turbine economies for moderate size units under the operating conditions noted.

As indicative of the improvement of economy in the use of the low pressure turbine an example of combined operation is illustrated.

The relative gain in economy and capacity at various loads is shown. All engine economies have been selected from results obtained in well equipped and maintained plants, which is evident from the steam consumption given. Obviously, when the engines operate on greater steam consumption, the benefit from the low pressure turbine will be correspondingly greater.

Recommendations

Your committee recommends that next year's committee take up for its work consideration of the general subject of the economical generation of power. We do not think that it should be confined too closely by a definite assignment of subjects, but should be in a position to select subjects under the above classification that would be of vital interest to the whole association, after receiving suggestions from the executive committee.

1200-VOLT D. C. CAR EQUIPMENT*

By F. E. Case, Engineer of Railway Equipment, General Electric Company

Direct current of 1200 volts has been adopted in preference to 600 volts as the trolley potential of a number of interurban and other railways on account of lower first cost and lower cost of operation. That 1200-volt current can be more economically delivered to the car requires little argument. On a railway having a given size and length of feeder a car equipped with 1200-volt apparatus will entail a line loss of only one-quarter that of a 600-volt car of the same size operating at a similar speed. With dense traffic, where cars are required to run on a very close headway, consequently giving practically a uniformly distributed load, the substations at 1200 volts can be located twice as far apart as at 600 volts for the same maximum per cent line loss.

Under the other extreme condition of two cars or trains only between substations and passing midway the substations can be located four times as far apart as at 600 volts with the same maximum per cent line loss. The latter condition, however, is rarely practical for interurban operation on account of the great headway between cars. Under the usual prevailing conditions of interurban service it will be found that the substations at 1200 volts can be located from 2½ to 3 times the distance apart as at 600 volts to give the same percentage line loss.

The adoption of commutating poles has made the operation of 1200-volt generators entirely practicable. Where alternating current is better adapted to long-distance distribution, rotary converters in substations are also well designed to translate the alternating current to 1200 volts direct. No more complicated or less reliable pieces of switchboard apparatus are required in the power house or substation than for the ordinary voltages.

Either the third rail or trolley wire can be used for carrying current to the car. One road is now successfully using the former and there are several others using the latter. The third rail is of the under-running type and is installed in a similar manner to a 600-volt practice, but the insulators are of somewhat increased dimensions.

No radical departure from standard 600-volt practice is required in the line construction to ensure a safe insulation. Cross suspension, side bracket or catenary method of trolley wire support can be used, but additional insulation over that used for 600 volts is, of course, required. The catenary form of suspension is usually recommended, as not only does it require a minimum number of poles and insulators, but it provides the most flexible support, which is a great advantage for high speed operation.

The standard trolley base, pole and wheel give better results than with 600 volts, as the current to be collected for a given weight and speed of car is only half, which increases the life of the wheel especially.

The motors are similar electrically to ordinary 600-volt commutating pole motors, with increased insulation, and there is no departure in mechanical features from other

*Abstract of paper presented on Section (k) of the report of the Committee on Equipment of the American Street & Interurban Railway Engineering Association, Denver, Colo., Oct. 4, 5, 6, 7 and 8, 1909.

direct current motors for lower voltage. The brush holders are located in a similar manner and there are no more of them, so that inspection is just as readily made as in other direct current motors. The commutation of the motors is so good that no more attention to the brushes and commutator is required than with low voltage motors of similar capacity. As the motors have the same electrical characteristics as other direct current motors, the armature speeds are no greater and in consequence the bearings are equally long lived.

Some motors have been furnished by the General Electric Company for operating directly on 1200 volts and others two in series. With the former it is possible to operate at only half speed on 600-volt portions of the line, but the latter motors can be connected in multiple so as to give the same speed on the low voltage as the high, which in many cases is a great advantage.

The car equipment consists of apparatus similar to that used for 600 volts, many of the parts being identical. Cylinder platform controllers have not been used in any instance, however, as they require the motor current to be carried above the floor and we have considered it advisable for obvious reasons to keep the apparatus that breaks the main circuit, under the car, where it can be suitably isolated.

Sprague-General Electric Type M control, comprising electrically operated contactors, a reverser and a circuit breaker is used. These parts are practically the same as for 600 volts with additional insulation where required. Both automatic control as described in my paper of last year for 600-volt operation and hand, or non-automatic, control have been furnished. The circuit connections are identical, for both the master control and the motors, to that used for 600 volts.

Standard 600-volt contactors, operated by means of electro-magnets, are employed for making the motor and resistance circuits in the contactor box, a few extra contactors being used to provide the necessary breaks in series to safely open the circuit. Practice has shown that a 1200-volt current can be very satisfactorily interrupted by the contactors, and that the burning is not excessive.

Proper insulation of the reverser contacts is easily secured, owing to the motor fields being reversed, instead of the armatures when the direction of car movement is to be changed, and also because the fields are connected to the ground side of the armatures. This connection of the motors has been adopted both in new cylinder controllers and type M control for 600 volts. For commutating pole motors, it is desirable, in order that the commutating field winding, which is permanently connected to one side of the armature, may always be on the ground side of the armature. The connection has also the advantage that fewer of the contacts have a high potential between them as the drop across the exciting field to be reversed is only about fifteen volts.

A magnetic blow-out circuit breaker, located under the car, similar to the one generally furnished with type M control, is used for an overload protective device. It is, however, provided with a more powerful magnetic blow-out and has an increased opening and insulation. The circuit breaker is set and tripped from the motorman's cab by means of the ordinary double-movement switch which connects to the proper train wires.

A magnetic blow-out copper ribbon fuse box is provided as an additional protective feature for the main circuit. Standard 600-volt cast-grid rheostats are used for providing the necessary resistance steps in starting the motors. These rheostats are effectually insulated from the angle irons to which they are attached by means of large collars and tubes surrounding the supporting bolts. A new design of cast-grid rheostat, has recently been brought out.

When a car equipped with four motors is required to operate at the same speed on both 600 and 1200-volt sections, it is necessary to use a commutating switch for changing the connections of the motors. For 1200-volt operation this switch connects the motors in two groups with the motors in each group in series, each group being handled as a single motor. This commutating switch is arranged for operating either by hand or with air controlled by a valve located near the motorman. An interlock device is provided which prevents operation of the contactors if the motors are not properly connected for 1200-volt running.

On some roads the operating conditions are such that only on the interurban sections is it desirable to obtain the maximum speed. To meet these requirements the commutating switch is, therefore, not necessary, and having 1200 volts on the high speed section and 600 volts on the city division gives relative speeds of about 2 to 1.

Six hundred-volt current is used for operating the control and also for the car lighting. With the earlier equipments the air compressors are also operated at this voltage. This current is obtained from a dynamotor, or motor generator, of waterproof design for mounting under the car.

The new feature of the dynamotor is a series field winding which is connected between the two halves of the armature and is provided with a tap at its center. In starting up, line current passes through the first half of armature, series field, and second half of armature to ground, thereby strengthening the normal field, and the machine operates as a compound motor. When current is being taken from the tap in the center of the series winding for the control of lights, the two halves oppose each other, and there is no effect on the field strength. When the trolley leaves the wire with the dynamotor running, and the controller on, there is an immediate tendency of the dynamotor to deliver current to the motors, due to the momentum of the armature and the shunt field. The series winding now comes into play by demagnetizing, or beating down, the field, since the direction of the current has been reversed in the first half of the series field, and the two parts, therefore, no longer oppose each other. This action prevents an amount of current sufficient to blow the dynamotor fuse being taken by the motors.

The dynamotor is a very simple device, both electrically and mechanically. No mechanical load being driven by the armature, the strains on the bearings are negligible and the parts are long-lived. On recent equipments the dynamotor is started up automatically, when the car runs onto a 1200-volt section, by means of a selector relay. The light and control circuits are disconnected from both the trolley and dynamotor when the relay is not energized, the proper connections being made to correspond with the voltage applied. To insure correct operation of this relay, a short, grounded section of trolley wire is interposed between the 1200 and 600-volt portions.

The electric heaters can be operated either from the dynamotor or directly from the 1200-volt circuit. As the conductors in the heater are insulated from the frame by porcelain, the requisite insulation is easily secured for 1200-volt operation.

The air compressors on some recent equipments are wound for operating at 1200 volts, as there is no difficulty in obtaining good commutation and insulation for this voltage. When the car is running on the 600-volt section the compressor will, of course, be required to operate for a longer period if air is used to the same extent as on the 1200-volt portion, but this is easily taken care of in selecting the proper capacity of compressor.

Denver is known as the City of Lights. No other city of the same size expends so large a sum through public and private channels for illuminating its streets. On the principal thoroughfares new and artistic lighting features have been adopted.

CAR WEIGHTS AS AFFECTING OPERATING COST*

By M. V. Ayres, Electrical Engineer, Boston & Worcester Street Railway

When it is suggested that a decrease in the weight of cars might be brought about without sacrificing carrying capacity or safety, the question is at once raised: "Will it pay?" In other words, will not the increased cost of building such lighter cars more than offset any saving to be effected in operating expenses?

This investigation was undertaken with the hope of throwing some light on the question of the relation between the weight of cars and operating expenses. It has been conducted by means of correspondence with car manufacturing companies, operating companies, and various gentlemen who were known to be interested in the subject; also by the consultation of text books and authorities in the effort to obtain theoretical data applicable to the matter.

The effort to obtain information based on actual tests or operating data has been largely barren, and therefore the theoretical discussion occupies the larger part of the paper.

Probably no argument is needed to show that an increase of car weights will cause an increase in the following items of expense:

(1) Cost of power; (2) cost of car repairs; (3) cost of track repairs; (4) fixed charges of power plant, and (5) fixed charges of distribution system.

While it is evident that these items will increase with car weights, it is not obvious that they will increase proportionately thereto. An attempt has been made in the following discussion to show the manner in which these various costs vary with the weight of cars.

Power Consumption

In Fig. 1, O A B C D is a typical speed-time curve, figured for a car of 50 tons weight, making a schedule speed of 30 m.p.h., with a stop every 5710 ft., and stops of 10 sec. duration.

The slope of the coasting line, B C, is determined by the train resistance, taken in this case at 14 lb. per ton. If instead of weighing 50 tons the car were very much lighter, the train resistance per ton would be greater and the slope of the coasting line would be steeper, like the line B_1 C_1.

In the figure the areas under the curves O A L N D, O A B C D, and O A B_1 C_1 D are equal; therefore in each of these speed-time curves the car travels the same distance in the same time. In the computations which follow, when cars of different weights are assumed to be operated on the same schedule, the calculations are based on speed-time curves like O A B C D and O A B_1 C_1 D; that is to say, the curves of acceleration and braking are kept the same, but the slope of the coasting line is changed to correspond with the calculated train resistance.

The energy required to propel the car on the speed-time curve O A B C D is equal to:

(1.) The energy to accelerate to the speed at the point B.
(2.) The energy to overcome train resistance to the point B.
(3.) Motor and rheostatic losses, proportional to (1) and (2).

The energy used in accelerating from point L to point B is all used in overcoming train resistance to point M, at which the speed is the same as at point L. Therefore the energy required for this speed-time curve may be re-stated, as equal to:

(1). Energy to accelerate to point L.
(2.) Energy to overcome train resistance to point M.
(3.) Motor and rheostatic losses, proportional to (1) and (2).

*Abstract of paper presented as Section (B) of the report of the committee on equipment of the American Street & Interurban Railway Engineering Association, Denver, Colo., Oct. 4, 5, 6, 7 and 8, 1909.

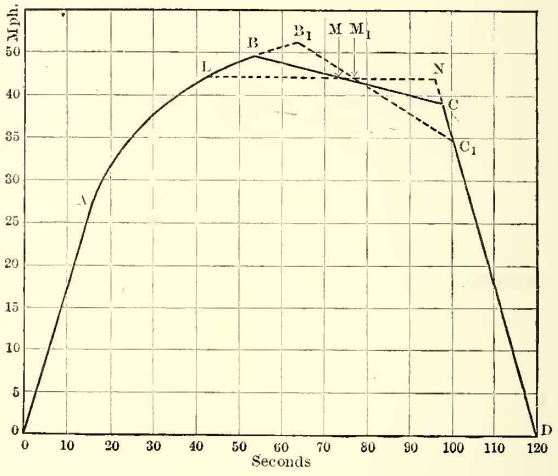
If we draw a series of speed-time curves for the same schedule, for cars of different weights, the point M shifts, as shown by the distance between M and M_1, but the total movement of this point is small, and in the computations which follow the point M is assumed constant for all cars on the same schedule. In computing the power consumption for cars of various weights, operating on the schedule, Fig. 1, the following quantities are calculated:

(1.) Energy required to accelerate one ton to speed of point L, 7 per cent being added to allow for the effect of rotating parts. The formula for this calculation is

$$E = .0205\ S^2$$

where E=energy in watt hours, and S=speed in miles per hour.
(2.) Distance traveled by car before reaching point M.
(3.) Average effective train resistance for the car in question. Then (2)×(3)×.000278=energy in watt hours to overcome train resistance. These figures give the energy per ton for the schedule in question, for the distance covered by the speed-time curve.

The curves of Fig. 2 are calculated for cars of various weights operating on the schedule of Fig. 1. Vertical distances correspond to watt hours per car mile and horizontal distances and to ton weight of cars. Curve A shows the energy required for acceleration only, for cars of all weights up to 50 tons. Curve B shows corresponding values



Car Weights—Fig. 1.—Typical Speed Time Curves for 50-Ton Cars, Speed 30 M.P.H., 10-Second Stops Every 5710 Feet

of energy to overcome train resistance only. Curve C is the sum of A and B. Curve D shows the total energy including motor losses to operate cars of all weights up to 50 tons on the schedule in question.

Curve B is calculated with the aid of Armstrong's formula for train resistance:

$$F = \frac{50}{\sqrt{W}} + .03\ S + \frac{.002\ a\ S^2}{W}$$

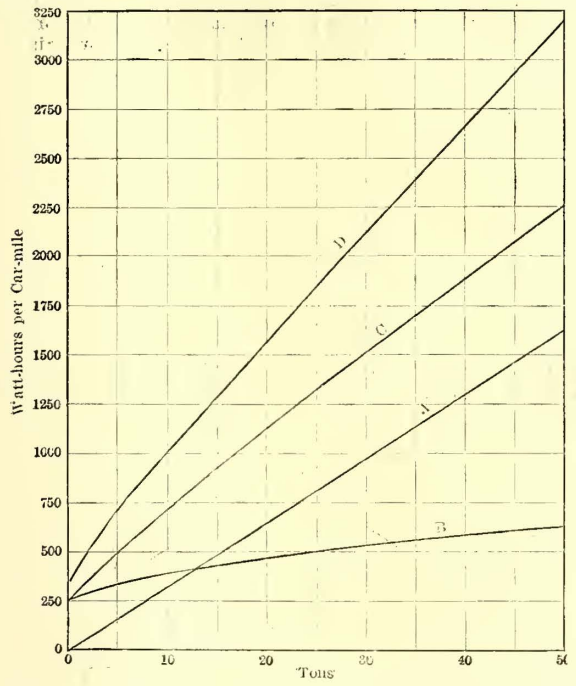
Where W = weight of car in tons; S = speed in miles per hour; a = area of car end in sq. ft. Throughout these computations a is taken at 92 sq. ft.

The important thing to notice about curve D is that it is substantially a straight line. If the energy were proportional to weight it would be a straight line through the origin, like line A. To show how closely this form of curve is followed under varying conditions, other schedules have been calculated.

Starting with Fig. 1 as a basis, other speed-time curves can be assumed, of the same shape, but of different sizes. Then all speeds and times will be proportional to the linear dimensions, and all distances to the squares of the linear dimensions. By the aid of this proportionality, and a special calculation in each case for the train resistance, energy curves can be calculated for other schedules, corresponding to speed-time curves of the same shape. By assuming new

speed-time curves of different shapes, further series of energy curves can be calculated in the same manner.

Such energy curves have been calculated for speed-time curves of the three shapes in Fig. 3. These were taken as illustrating widely differing characters of service, curve X requiring one stop every 3 minutes, curve Y one every 90 seconds, and curve Z one stop every 70 seconds, allowing 10 seconds duration for each stop. On the basis of these three



Car Weights—Fig. 2.—Energy Curves for Cars of Various Weights Operating on Schedules Shown in Fig. 1

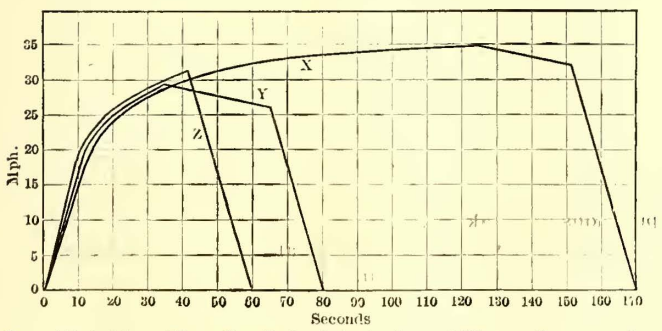
curves, changing the dimensions in the manner above described, the energy curves of Fig. 4 have been obtained. These show the energy in watt-hours per ton mile required for cars of various weights from 12.5 to 50 tons, operating on various schedule speeds, and on speed-time curves of shapes similar to the curves X, Y and Z of Fig. 3.

These curves are all very nearly straight lines represented by the equation

$$E=a+bW,$$

when E=the energy per car mile, a is the intercept of the curve on the Y axis, and b is the slope of the curve.

This equation will therefore be adopted as correctly representing the relation of weights of car to power consump-



Car Weights—Fig. 3.—Calculated Speed-Time Curves for Various Kinds of Service

tion in all cases of like schedule, the constants a and b being dependent upon the frequency of stops and schedule speed attained.

This formula may be expressed:

$$P=\frac{p}{n}(a_p+b_pW).$$

where P=cost of power per car mile in cents; p=cost of power per kw-hour in cents; and n=efficiency of transmission, power house to car.

For ordinary frequent stop service, when the schedule speed is forced up to about the highest point permitted by frequency of stops, probably conditions intermediate between those of curves Y and Z would obtain, and the power consumption would be about that indicated by the broken line on Fig. 4. The equation of this line is:

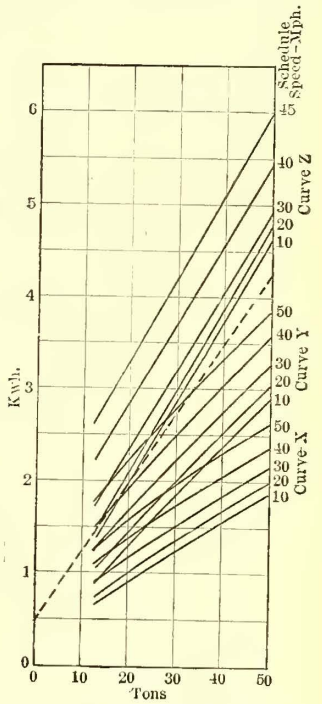
$$E=.500+.075\ W$$

If we assume that the cost of power per kw-hour is one cent, and the efficiency of transmission to the car 75 per cent, this becomes:

$$P=.667+.1\ W,$$

which is believed to fairly represent the cost of power in cents per car mile under average conditions.

These equations indicate that the cost of power is divided into two portions, one of which is independent of the weight of car, and the other proportional thereto. In the case assumed the cost is 0.667 cent per car mile, irrespective of weight of car, plus 0.1 cent per ton of car weight. The value of both the constants a and b in the general formula is dependent upon the formula used in calculating train resistance. If train resistance were proportional to weight the constant a would disappear, making the power cost exactly proportional to weight. The formula used is believed to represent average conditions, as near as present information will permit, but would not be correct in some special cases.



Car Weights—Fig. 4

The use of ball bearings, for instance, would give rise to a different formula, and would reduce the value of the quantity a. The figure 0.667 for a is undoubtedly too high for ordinary city conditions, which are more nearly represented by the line corresponding to the schedule of 10 m.p.h., curve Y, Fig. 4. This indicates but about 0.28 cent per car mile as the part of power cost independent of car weight. The curve chosen (the broken line) is more nearly that of elevated railway or frequent stop interurban service.

Cost of Car Repairs

An increase in car weight involves an increase in the weight and cost of all replacement parts, this cost being nearly but not quite proportional to the weight. If the increase of weight is accompanied by proportional increase of strength and bearing surfaces, the life of parts should not be decreased, the sole increased cost of repairs being due to the greater cost of replacement parts. However, such proportional increase is not possible in many parts, such as trolley wheels, gears, brakeshoes and wheels, all of which wear out much faster with heavy cars than with light ones. On the other hand, some items of car repairs are independent of weight, such as painting and replacing broken glass.

Data are lacking with which to make a close analysis of the variation of these factors of car repairs cost, but their nature, as above stated, points strongly to an equation of the same type as that given for power consumption.

If R=cost of car repairs in cents per car mile,

$$R=a_r+b_rW.$$

From data of the ratio of cost of repairs to cost of power

on a number of large systems, it is believed that values of a_r and b_r as given in the following equation, are about correct:

$$R = .46 + .07\,W.$$

Cost of Track Repairs

It is evident that a certain part of the cost of track repairs would be incurred irrespective of use, as decay of ties and corrosion of metals, and injury from teaming would go on just the same. Otherwise, wear is evidently about proportional to ton mileage. If track construction is much too light for the car weight, doubtless the wear would increase faster than the weight, but with tracks suitable to the traffic, it is probably closely proportional.

This evidently again calls for an equation similar to that for power consumption.

If T = cost, in cents per car mile, of track repairs,

$$T = a_t + b_t W.$$

The relative values of a_t and b_t will depend upon the proportion of natural deterioration to wear, a_t increasing with decreased frequency of service, and with increased use of the road-bed for other traffic.

Both a_t and b_t will vary with the weight of rail, quality of ballast, and other details of track construction.

It is believed that the following equation gives fair average values of a_t and b_t:

$$T = .43 + .026W$$

Fixed Charges of Power Plant

It is evident that the size and cost of the power plant will be proportional to the power requirements of the cars, and that, therefore, the equation connecting fixed charges on power plant with car weight will be of the same type as that connecting power cost with car weight.

If C = fixed charges on power plant in cents per car mile, then,

$$C = \frac{kp}{n}(a_p + b_p W).$$

where k is a constant connecting fixed charges with cost of power. Assuming fixed charges at one-half the power-production cost, we have as an average value:

$$C = .333 + .05\,W.$$

Fixed Charges of Distribution System

For any railway system, a certain minimum of investment in trolley wire and feeders is required, and in addition an investment nearly proportional to the power demand. Evidently this condition will be met by an equation of the same type.

If F = fixed charges in cents per car mile on distribution system,

$$F = a_f + b_f W.$$

The values to be assigned to a_f and b_f will vary enormously with different characters of road, being very much greater for the interurban than for the city system. For an interurban road it is believed that the following is a fair average:

$$F = .32 + .02\,W.$$

Total Costs Affected by Weight

We are now in a position to construct a formula expressing the total cost of operating cars, so far as that cost is affected by car weight. Let M = total of the following costs per car mile; cost of power, cost of car repairs, cost of track repairs, fixed charges of power plant, fixed charges of distribution system.

$$M = P + R + T + C + F, \qquad \text{where,}$$

$$P = \frac{p}{n}(a_p + b_p W)$$

$$R = a_r + b_r W$$

$$T = a_t + b_t W$$

$$C = \frac{kp}{n}(a_p + b_p W)$$

$$F = a_f + b_f W.$$

This summation will evidently take the form:

$$M = a_s + b_s W.$$

If we substitute the average values as assumed above, this becomes

$$M = 2.21 + .267\,W = \text{cents per car mile.}$$

This evidently means that the five items of expense above enumerated cost 2.21 cents per car mile, no matter what the weight, and in addition 0.267 cent per ton mile.

Substituting different values of W we may obtain the cost of operating cars of various weights, under the conditions assumed, for the five items of operating cost above considered.

The following table is so compiled.

Cost in Cents Per Car Mile to Operate Cars

Weight Car.	Cost.		Total Cost.
Tons.	a_s	$b_s W$	M.
10	2.21	2.67	4.88
15	2.21	4.00	6,21
20	2.21	5.34	7.55
25	2.21	6.68	8.89
30	2.21	8.01	10.22
35	2.21	9.35	11.56
40	2.21	10.68	12.89
45	2.21	12.00	14.21
50	2.21	13.35	15.56

In estimating the expensiveness of car weight we should consider only that part of operating cost which is proportional to weight, or in the cast assumed, 0.267 cent per ton mile. If a car runs an average of 150 miles per day this amounts in a year to $150 per ton. That is to say, it costs $150 per year for every ton, or 7.5 cents per year for every pound of weight in a car.

If it costs 7.5 cents per pound per year to carry around weight it evidently is worth many times that much to get rid of weight. If the car were a permanent investment it would be worth, at 5 per cent, 20 times 7.5 cents, or $1.50 for every pound we could reduce weight. If, on the other hand, we suppose that at the end of 15 years the car will be scrapped, we can consider the 7.5 cents per year saving as an annuity to continue for 15 years, and then cease. A table of annuities shows the present value of 7.5 cents for 15 years at 5 per cent to be 78 cents. According to this we can afford to pay 78 cents per pound, or $1,560 per ton to reduce car weight.

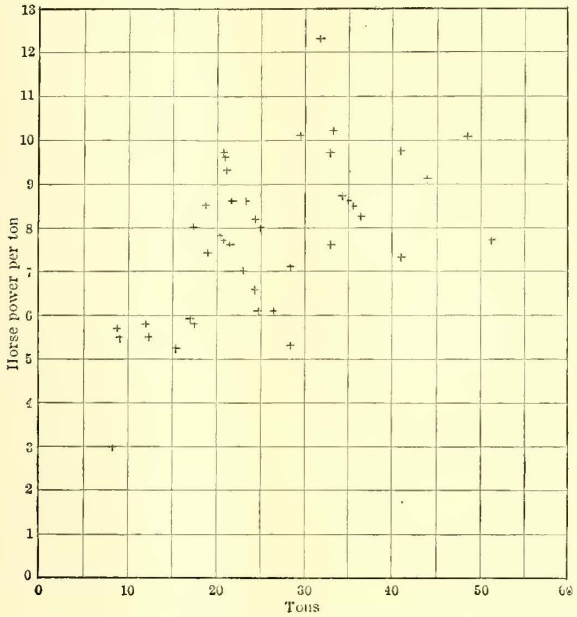
Of course these values will vary over a wide range.

The curves of Fig. 4 show how widely the power cost will vary with different schedules. All of the other costs will vary in a similar manner. Each case must be considered on its merits. It is believed, however, that the general form of equation of the straight line intercepting the axis of Y above the origin will very closely represent the actual conditions in all cases. There will always be a portion of the operating cost, represented by a in the formula cost = a + b W, which is independent of weight, and another part which is proportional to weight. The finding of any two points on the cost line is sufficient to establish the line. For instance, if it is found that under certain conditions the operating cost for a 40-ton car is $6,000, and for a 30-ton car $5,000, it will be safe to figure the cost per ton at $100, and the formula becomes, cost = 2000 + 100 W.

While, as above stated, the cost of carrying around weight will vary in each case, it is believed that the figure of 7.5 cents per pound per year is a fair average value and by no means an extreme case. An effort has been made to get data from various operating companies as to their estimate of this cost. Very little data have been forthcoming, but what have been secured show a general tendency in several

large city systems to estimate it at 5 cents per pound per year. This is not at all inconsistent with the figure of 7.5 cents above given, which corresponds more nearly with interurban conditions. Even at 5 cents per pound per year, we can afford to pay $1,000 per ton for a reduction in car weights.

At this figure, if we could reduce the weight of a 28-ton car to 14 tons, without reducing its carrying capacity, safety or speed, we could afford to pay $14,000 more for the lighter car. Even if a much lower figure than $1,000 per ton is

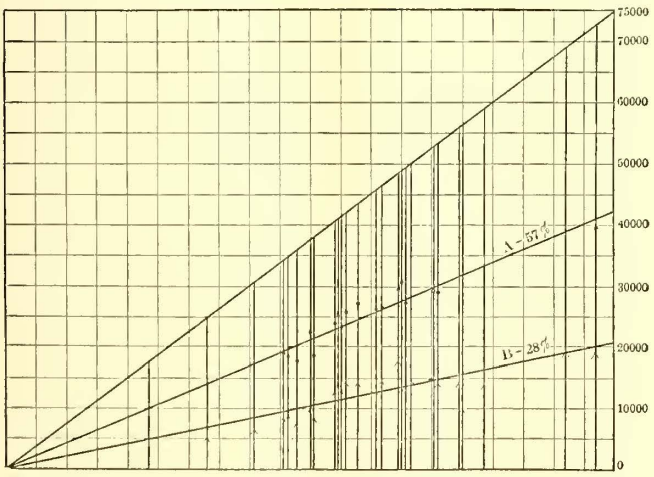


Car Weights—Fig. 5.—Motor Horsepower Per Ton for Cars in Actual Service

taken, it is evident that it will still be a good investment to spend a great deal of time and money in solving the problems of producing lighter cars.

Electrical Apparatus

The weight of any electrical car is partly due to its electrical apparatus. It is interesting to inquire how great a proportion of the total weight must be assigned to this pur-



Car Weights—Fig. 6.—Relative Weights of Electrical Equipment, Trucks and Car Body

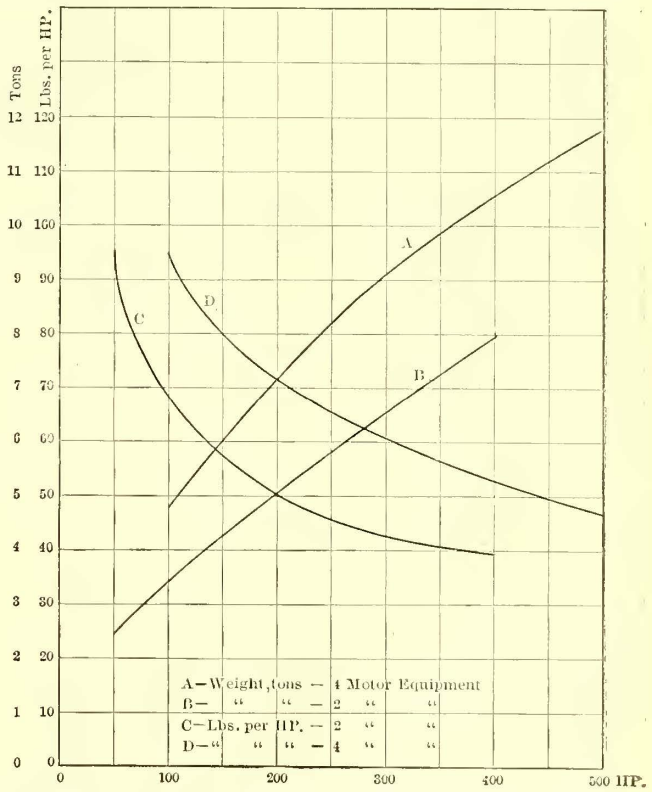
pose. If we assume that it is permissible to load a motor to 25 per cent over its commercial rating during acceleration, a formula for the motor horsepower required per ton would be:

$$H.P. = .208\,AS.$$

where A = rate of straight line acceleration in miles per second, and S is speed in miles per hour at the end of straight line acceleration. Seven per cent is allowed for effect of rotating parts. For any given shape of speed-time curve, S is proportional to schedule speed, and therefore horsepower is proportional to schedule speed.

Fig. 5 shows the actual motor horsepower per ton in a number of cars in actual use, plotted with reference to weight of car. Evidently there is no relation between the weight of car and the horsepower per ton, but in practically all cases the horsepower per ton falls between 5 and 10.2. Of the two extreme cases, 3 and 12.3 hp per ton, the former is a light 16-ft. box car with one motor and the latter is an English tunnel car for train operation, probably intended to be used with trailers. No doubt interesting results could be shown by plotting horsepower per ton with reference to schedule speed for these cars, but the data are lacking.

Fig. 6 has been plotted to show the relation between the weights of electric equipment, trucks and carbody of cars in common use. Each vertical line represents a car, the height indicating the total weight of the car. The height of the arrow-head on each line indicates the weight of electric equipment, and the height of the dot indicates the combined weight of the electric equipment and trucks. Sloping



Car Weights—Fig. 7.—Relation Between Size and Weight of Electrical Equipment

lines A and B, drawn through the mean position of these points, indicate that, in general, electric equipment weighs about 28 per cent of the total and trucks about 29 per cent, or a total for electric equipment and trucks of 57 per cent. The other 43 per cent is apportioned to car body plus all other equipment.

Fig. 7 shows the relation between size and weight of electric equipment. The curves are plotted to give as nearly as possible the average weights of commercial equipments, the weights including motors, gears and all control apparatus. Curves A and B show the weight in tons of 4 and 2-motor equipments, and curves C and D show the weight in pounds per horsepower of 2 and 4-motor equipments. The 4-motor equipments are just about 40 per cent heavier than the 2-motor of the same power for the entire range from 100 to 400 hp. The 2-motor equipment is also cheaper in first cost and should be preferred unless more than 400 hp per car is required, or conditions of traction are such as to require 100 per cent of weight on drivers.

The fact that the average car body is only 43 per cent of

the whole weight of the car should not lead to the conclusion that a reduction in the weight of car body itself is comparatively unimportant, because that can and should be accompanied by a nearly proportional reduction in the weight of motors and trucks.

In the hope of getting some indication of the direction in which to seek for weight reduction, an effort has been made to get detail weights of component parts of cars. This has met with little success. One sheet has come to hand as follows:

Weights of Semi-Convertible Car

28-ft. body, 40 passengers, K-28-J control, 4 G E 80 motors.

Car body without seats	14,820
Seats	1,180
Trucks	14,200
Electric equipment	14,250
Air brake equipment	1,300
Hand brake	278
Wire	256
Conduit, pipe, etc.	652
Hangers, bolts, etc.	651
Heaters and switches	197
Snow scrapers, fenders, draw bars	580
Trolley base, etc.	190
Miscellaneous	152
Total	48,700

While of course no detail is too small to be of importance, it appears from the above list that miscellaneous fittings do not constitute a very large part of the weight. The car body itself is the best place to start to reduce weight. A lighter car body permits lighter trucks. Lighter trucks and car body require less power to move and therefore call for lighter motors.

Interest in the subject of reducing car weights seems to have been rapidly developing during the past year or two. A number of operating companies have been investigating methods of reducing weights and have made encouraging progress. One company has designed a malleable iron body bolster to take the place of a built-up steel plate bolster for its standard cars. The new bolster is shown by test to be much stronger than the old one, but is 109 lb. lighter, making a reduction of 218 lb. per car, which is a saving worth, at the average value above estimated, of 78 cents per pound, about $156 per car.

Another company has just contracted for new cars which are 2 ft. longer than their old standard, and 2000 lb. lighter, besides being undoubtedly stronger. This result is attained by a partial steel frame construction and the use of a turtleback roof in place of the monitor deck.

One large Eastern company has closed contracts for cars and trucks, after receiving bids upon specifications drawn to emphasize the importance of light weight. The contracts finally signed specify weight limits which must not be exceeded, and include agreements on the part of the builders to furnish the customer with detailed weights of each and every component part as actually constructed. As a result, the new cars are to be 4000 lb. lighter than cars of the same size now in use by the company.

The double truck car body may be regarded as a bridge structure supported at the bolsters and overhung at both ends. The two car sides can be designed as trusses, resting upon and connected together by the bolsters, which are themselves shallow trusses carrying the load to the center plates. This elementary truss frame can be designed so as to be extremely light and still be amply strong to bear its load. The simplicity of the problem is badly interfered with by the necessity for platforms, which are very awkward to attach and disproportionately heavy, and become more troublesome as their length is increased. The problem is still further complicated by the necessity of providing for drawbar strains, and the uncertainty as to the strains set up by the motion of the car.

It is probable that the correct principle to work on in designing cars for lightness is to provide first a strong steel frame to take the known strains, and secondly to use the lightest possible material for all parts intended, either to separate the car interior from the outside atmosphere or to provide ornaments and conveniences.

It is noticeable that in every case brought to light in this investigation, where car weights have been reduced, this has been accomplished, at least in part, by the use of steel in place of wood. The fact is that weight for weight, in almost all forms, steel is stronger than wood, the superiority becoming very pronounced in some special shapes, such as I-beams, to which steel is especially adapted. This is true of ordinary structural steel, and some of the special alloy steels are even very much stronger and undoubtedly can be advantageously used in some places.

Hard wood is heavy material. For some purposes a light wood can be used equally well and probably some form of fiber in thin sheets can take the place of wooden panels with much saving of weight. Aluminum can be used in sheets for siding and as castings to take the place of bronze fittings. Common cast iron should be excluded altogether from car construction. It has no use for which some other material would not be lighter and better.

In the matter of truck construction, probably pressed steel can be utilized to reduce weight to a marked degree. Hollow axles of high-strength steel are also a hopeful possibility.

Electric equipment can undoubtedly be reduced in weight. Probably the greatest reduction can be accomplished by designing motors for large commutating capacity and using forced ventilation. It is possible that radically new designs may be made, permitting of lighter construction. Perhaps a combined motor and truck built as one machine may solve some of the motor and truck problems.

From an engineering standpoint, the problem of transportation is primarily one of moving certain weights from point to point on the earth's surface. In the ordinary electric passenger car, the dead weight is from three to ten times the live weight when all the seats are occupied, while the average condition of loading would show a much larger proportion of dead weight. In other words, the weight efficiency is not better than from 10 to 30 per cent, under the best conditions, and drops to nearly nothing under the worst.

The reduction of the proportion of dead weight to passengers carried seems to hold out greater promise of economy than any other line of improvement at present discernible in the field of transportation engineering.

GERMAN ENGINEERING TITLES

The engineering titles used in Germany are often confusing to the average American, so that a short explanation of some of them may be not only interesting, but instructive in the case of visitors from abroad. The length of the title in Germany often bears little relation to the responsibility of the office. Thus Regierungs-baumeister sounds important but it signifies only the lowest grade of bureaucrat. Even shoemakers often call themselves meister or master, the implication being that they are not apprentices. The ascending of dignities in the government service is something like this: Baumeister, Baurat, Geheimbaurat, Ober-Geheimbaurat, Wirklicher (or genuine) Geheimbaurat and at the top of the heap a very simple RAT!

The term Ober-Ingenieur, if literally translated, means chief engineer, but, in reality, it refers to the title of the head of any engineering department. The immediate assistants of such an official are designated by the title Ingenieur (engineer). The term Direktor means manager, but it is not exactly synonymous with the English term "manager" as a large electric railway company may have several Direktors, each in business charge of some part of the organization.

REPORT OF COMMITTEE ON EXPRESS AND FREIGHT TRAFFIC*

By P. P. Crafts, Chairman; A. Eastman, G. W. Parker, E. H. Hyman, Frank Walsh and C. V. Wood

The committee on express and freight traffic submits the following report, together with certain criticisms and recommendations, which seem appropriate to include herein.

Of the total number of member companies from which information was requested, 39 submitted data bearing on the subject of express and freight up to the date of this report, namely, Aug. 19.

Your comittee requested information of a very vital nature and covering considerable ground. Perhaps a natural hesitancy to give out information of this character, even with the assurance of your committee that it would be treated in a strictly confidential manner, accounts for the absence of reports from several companies.

The committee believes, however, that the information received indicates so clearly the manner in which express and freight traffic is handled by electric railways in various parts of the country that definite recommendations can be made by your committee.

The tables accompanying this report show in detail the manner in which the various member companies reporting solicit traffic, the proportion of express and freight earnings to total gross earnings, freight earnings per mile of road, the manner in which accounts of the express and freight departments are handled, and the various conditions under which the companies conduct their express and freight business.

Company	Passengers, etc.	Mail	Express	Milk	Freight	Switching	Total Freight Revenue	Length of Line	Population Outside of Terminals	Population including Terminals	Passenger Revenue per Mile	Per cent of Total Revenue	Mail, Express and Freight Revenue per Mile	Per cent of Total Revenue	Total Revenue from Transportation per Mile
1	$36,558.64	$395.62			$1,294.80		$1,690.32	0.	20,000	35,000	$5,222.66	96 0	$241 47	4.0	$5,464.13
2	539,849.37	277.44	$200.00				477.44	75	105,000	853,000					
3	1,390,030.83	1,121.15	1,950.00		62,994.47	$2,036.30	68,101.92	91.4			15,244 19	95.3		4 6	15,989.44
4	255,510.41		12,822.27	$6,422.80			19,245.07	30.	50,000	550,000	8,517.01	93 0	631 50	7.0	9,158 51
5	683,191.00	2,700.11	33,165.47	28,639.20			64,504.78	169.	70,000	720,000	4,054 38	90 5	381 93	8 5	4,436.01
6	363,205.37		9,732.94		14,593.94		24,326.88	34.4	3,805	61,200					
7	90,186.49	150.00	1,359.05				1,489.05								
8	849,774.37	953.97	46,233.53	4,311.75			51,499.25	62.5	25,800	317,300	13,646 57	94 3	824 38	5 7	14,470 95
9	98,912.43	1,481.16	7,097.26		10,689.98		19,268.40	26.4	8,000	78,000	2,443 88	78 0	683 28	22 0	3,127.16
10	84,985.69	1,045.95		134.75	21,381.49	1,315.08	23,877.27	41.3		2,060.00	78.0		578 00	22 0	2,638 00
11	86,719.46			1,328.99	10,881.52		12,210.42	33.		80,000	2,800.00	87 0	400.00	13 0	3,200.00
12	319,210.61	787.97	14,033.02				14,933.02	45.7			6,984.91	95.0	307.06	5 0	7,070 07
43	387,371.25		8,140.14		42,416.47		50,556.71	139.0	40,000	160,000	2,786.84	88 5	193.72	11.5	3,150.56
14	680,241.88	950.52	23,382.36	2,970.76	135,601.28		162,904.92	365.0			4,003.30	91 2	246.32	8 8	5,049.68
15	110,331.75	717.56	3,069.67		16,596.88		20,384.11	36.1	7,000	90,000	1,056.25	84 4	864 68	15.6	3,020.93
16	315,575.86		14,201.99				14,201.99	34.8	5,000	385,000	9,660.00	95.7	407 00	4 3	9,468.00
17	44,601.19	309.16			14,395.90		14,705.26	14.6			3,950 70	75 0	1,005.82	24 1	4,068.73
18	949,543.93	732.80	5,306.42	7,322.45	28,624.20		41,985.93	116.	25,000	200,000	5,000 00	95 0	365.00	5 0	5,365.00
19	549,408.50	280.07	2,011.99				2,292.16	58.4	5,000	65,000	9,407.68	98 0	39.24	2 0	9,446.92
20	51,255.18	458.34			16,578.26		17,036.60	11.6	3,200	394,397	4,399 59	74 8	1,462.37	24 9	5,861.63
21	87,584.32				4,212.92		4,212.92	14.2			6,167.91	93.0	296.70	4 5	9,464.61
22	402,432.78	978.00	3,225.46				4,203.40	34.7			11,597.49	98.7	121.11	1 3	11,718 60
23	105,618.60	1,033.71	2,585.07				3,618.78	25.0	50,000	100,000	4,224 74	96.8	144.75	3.2	4,369.49
24	2,208,051.09	4,226.61	24,321.43	15,292.15	148,266.76		192,106.95	617.4	500,000	1,400,000	3,576.25	92.0	311.14	8 0	3,887.39
25	269,073.95				11,369.05		11,369.05	33.7	15,000	90,000	8,000.00	95.0	350.00	4.1	8,350.00
26	62,229.97	249.98	209.15		4,262.18		4,721.31	10.3	6,000	25,000	6,047.02	92.6	458.78	7.03	6,530.28
27	77,960.81		3,195.70		36,252.89	34,095.50	73,544.14	8.0	4,000	96,000	9,743 10	51.4	9,193 01	48.5	18,945 52
28	374,671 25	175.00	6,077.50		14,790.40		21,042.90	57.5			6,516.02	94.7	365 95	5.3	6,881 97
29	55,846.00	259.83			3,006.84		3,266.67	15.5	2,000		3,603.00	94.4	210.75	5.6	3,813 75
30	233,218.81	320.00	4,136.91		29,638 41		34,085.32	54.0	18,000	238,000	4,318 85	87.2	631 21	12.8	4,950 28
31	106,516 75		3,767.55	37.30	9,571.66		13,376.50	43.0	13,000	90,000	2,552.52	88.0	320 55	11.0	2,873 83
32	1,842,141.72	1,173.47	38,643.44				39,816.91	55.5			33,203 71	98 0	717.68	2.0	33,921.38
33	221,334.90				2,716.70		2,716.70	44.0	9,700	34,700	5,030 34	98.5	61.74	1.5	5,092 04
34	368,801.41	1,251.83			16,922.85		18,174.68	71.4	10,000	75,000	5,166 00	95.0	253.18	4 4	5,419 80
35	374,295.79				3,684.71		3,684.71	22.3		50,000	16,794 36	98.0	165.33	2.0	16,957 80
36	1,017,101.27	584 26	60,383.33	991.40	936.50		62,895.49	46.0	28,100	134,300	22,110.89	94.18	1,367.29	5 82	23,478.18
37	1,284,066.10	587.56	4,541.90	1,006.47			6,135.93	19.0	10,000	140,000	67,582 42	99.52	322.94	0.48	67,905 36
38	164,549.56	892 08	21,897.12	3,545.67	179.64		26,514.51	39.1	5,000	215,000	4,210 59	85.90	678 46	13 85	4,889.05
39	243,928 89		17,838.11	1,786.84		1,417.50	21,042 45	43.0	13,000	238,000	5,585 84	92.06	483 11	7 94	6,069 67

No. 503

Freight and Express Traffic—Table I

Soliciting

It is evident that, compared with a few years ago, a majority of interurban railways have greatly increased their express and freight traffic, generally upon a profitable basis. A number of companies originally entering the business in a tentative manner have ascertained that in the absence of restrictive physical conditions and without stringent state or municipal regulations there is a reasonable profit in the business, if conducted in a conservative manner, particularly with regard to costly terminals and expense of solicitation, etc. Numerous companies have been able to obtain sufficient traffic to see the necessity of increasing terminal facilities and to enlarge their organizations in various directions.

Steam railways are built with the primary intention of handling freight, their terminals are arranged accordingly, and recent statistics have shown that about 70 per cent of the earnings of the steam railways of the United States are obtained from express and freight, and only 30 per cent from passenger traffic. Diametrically opposite, the interurbans in the past have been built to obtain their earnings from passenger traffic, the express and freight business being merely a means of increasing their miscellaneous earnings. The situation, however, is rapidly changing, and interurbans are now being financed on the basis that a considerable percentage of their earnings shall be obtained from express and freight traffic, their charters, franchises and terminals being arranged to cover the situation.

Five years ago there were very few interurbans whose mail, express and freight traffic per mile of road exceeded $100 to $150. Of the 39 member companies reporting, very few interurbans reported such earnings less than $150 per mile; 5 report earnings of between $150 and $300, and 24 report earnings varying from $300 to $1,000 per mile. A few companies reported earnings per mile considerably in excess of the meximum amount above mentioned, but the conditions under which these companies operate their express and freight business are exceedingly favorable; in fact, put some in the class of interurbans whose express and freight traffic is their greatest source of revenue.

Some of the companies reporting indicate that they do not conduct a general express and freight business, but merely carry packages on passenger coaches, and will probably never enter the express and freight field, owing to local conditions.

Recommendations

The majority of the reports received indicate that the development of express and freight traffic on the majority of interurbans is increasing at a reasonable rate. Your committee finds a general tendency to adopt the official classifications and tariffs used by the steam railways in the territory in which the electric railways operate.

Certain criticisms and recommendations are made, which

*Abstract of report read before the American Street & Interurban Railway Transportation & Traffic Association, at Denver, Colo., Oct. 4, 5, 6, 7 and 8, 1909.

the committee trusts will be received by the member companies in the intended spirit, and which recommendations we believe will be to their final benefit.

It is the opinion of the members of this committee that many companies do not pay sufficient attention to the matter of solicitation. The steam railways have ascertained from years of experience that even a small freight business requires the employment of an intelligent force of solicitors to obtain and properly increase the traffic coincident with the increase of business in the territory which they serve. We can well draw a good lesson from their experience, and conduct the solicitation for our express and freight traffic along similar lines.

Where the conditions do not warrant the expense, it is not necessary for a comparatively short interurban railway to engage the services of high salaried men. The employment of a good live man, who not only solicits traffic for his road in opposition to competitive railways, but who finds and makes markets for the various commodities originating in his territory, and who, for instance, induces the raising of crops or of market garden supplies, which can readily find a market in the terminals reached by his road, will greatly increase the freight handled by it, and at a very nominal expense. It is, of course, a well known fact that, in general, the greater the business transacted by any organization the less the unit cost becomes therefor. In many instances the employment of a good freight solicitor marks the line between an unprofitable and a very profitable freight business.

We also find that some companies are inclined to provide very expensive freight handling facilities before they know whether or not the revenue received will warrant the expenditure. In many cases it would be better to rent freight terminals and after the business grows to the proper point, to provide other terminals and facilities, which from experience would be properly located and the expense for maintenance commensurate with the revenue obtained. Many companies are deceived in the matter of expenses, and instead of keeping an accurate account of them, many of the items are estimated and the estimates in many cases are entirely too low. For instance, one large interurban company, reporting earnings of considerably over $100,000 per year, estimates its expense for blank forms, etc., at such a that figure that it is immediately apparent as being altogether too low. Other companies in their estimates of expenses place too high a figure on the cost of power, track maintenance, etc., charged to the freight department. Such a procedure may discourage a company from continuing in the freight business when a careful analysis of the situation, backed by accurate accounting, would show them beyond a doubt that they were operating at a profit.

Apparently very few companies charge interest against the equipment necessary for the conduct of their express and freight business, only two companies so reporting. Many companies did not report their investment in terminals, equipment, etc., and, judging from the earnings of other companies and their reports of investment, the former apparently do not know their investment, or have given the mater no atention. Some companies do not make any charges for track maintenance, and so on, indicating that they do not know the exact status of their express and freight business and the direct relation of earnings and expenses.

The committee recommends that some action be taken by this association to prescribe a standard method of express and freight accounting, which can be adopted in whole or in part by the member companies, according to the amount of business transacted or the local conditions under which the business must be conducted.

The commitee also urges upon the member companies the importance of adopting standard blank forms, namely, bills of lading, way bills, expense bills, etc., as nearly as possible like the forms now used by the steam railways, and which are prescribed by the Inter-state Commerce Commis-

Company	Rate Participation with Steam Railroads: Joint Rates	Rate Participation with Steam Railroads: Two Locals	Equipment Furnished	Electric or Steam Locomotives	Reason	Old Line Express Company	Does Express Company Handle Local or only Foreign Business	Basis of Compensation	Own or Rent Terminals	What Municipal or State Restrictions
1										
2	No.	No.		Electric	More economical	Yes.	Both.	10 cents per 100 foreign 45 per cent. local	Own	
3	No.	No.				Yes.	Foreign.	Tonnage basis		
4										
5	No.	No.		Electric	Better service	No.			Own	
6										
7	No.	No.				No.			Rent	
8	No.	No.				Yes.	Foreign.	Tonnage basis	Own and rent	
9	No.	Yes.	7 box cars	Steam	Power house too small	Yes.	Both.	45 percentage on mileage basis.	Own except one	
10	No.	No.				Yes.	Both	1½ times 1st class freight rate.	Own and rent	None
11	No.	No.				No.				
12	No.			Electric	More economical	Yes.	Both.	Percentage and guarantee	Own and rent	None
13										
14	No.	No.		Electric	System used	Yes.	Both.	Percentage and guarantee	Own most	None
15	No.	Yes.		Electric	More economical	Yes.	Foreign.	20 cents per 100 lb.	Rent	None
16	No.	No.				No.			Own	None
17	Yes.	Yes.	None	Electric		No.			Own and rent	
18	No.	No.				Yes.	Both.	Tonnage basis	Rent	None
19										
20	No.	No.		Electric	Electric road	No.				None
21	No.	No.								
22	No.	No.				No.		15 per cent. of express Company earnings.		
23										
24	Yes.	Yes.	Locomotives	Both		Yes.	Both.	Earnings and minimums	Own and rent	None
25	No.	No.				No.			Own	None
26	No.	No.								
27	Yes.		None	Steam		No.				
28	No.	No.				No.				
29	No.			Electric		No.				
30	Yes.	Yes.	None	Electric	Have no steam	Yes.	Both.	50 per cent. local, pro rated foreign	Own	Under special arrangements
31	No.	No.				Yes.	Both	Flat rate per 100 lb.	Own and rent	None
32	No.	No.				No.			Own	None
33						No.				
34	No.	No.				No.			Own and rent	None
35	No.	No.		Electric	Have no steam	No.				None
36	No.	No.				No.			Own	None
37	No.	No.				No.				None
38	No.	No.		Electric	No heavy trains	No.			Own most	Cannot use streets between 6 a.m. and 8 p.m.
39	No.	No.		Electric	No heavy trains	No.			Own most	Cannot use streets between 6 a.m. and 8 p.m.

Notes.—Some companies operating both city and interurban lines include passenger earnings of city lines, hence their reports are not strictly accurate. The majority of reports from interurban lines are correct and can be considered representative as to general practice in conduct of freight business. Blank spaces indicate that information was not given or placed under another head. No companies have reported payments to cities or towns for the privilege of engaging in express or freight business.

Freight and Express Traffic—Table II

sion. Many companies would, by the adoption of such blank forms, eliminate a great many claims for shortages and damages which now confront them, of which many are settled because of lack of proper information as to the disposition of such shipments while in their care.

The committee also recommends that careful attention be paid to the handling of claims for shortages and damages, many of which are excessive and fraudulent. Proper heed paid to this feature of the express and freight business, and the organization of a claim department, even if small, will greatly reduce number and amount of such claims.

Freight and Express Traffic—Table III

Company	Salaries of Solicitors	Salaries of Clerks	Salaries of Other Office Employes	Wages of Conductors, Motormen and Trainmen	Rent of Buildings, Etc.	Insurance and Taxes	Books, Forms and Stationery	Power	Basis Charged	Maintenance Freight Equipment	Maintenance Track Roadway Etc.	Basis Charged	Damage Account Revenue	Per Cent.	Express Wagon Delivery	Other Charges	Total Expense	Amount	Track Rentals Basis	Investment	Tariff and Classification
1	$20 85		$3,477 75	$7,728 76	$295 61	$447 36	$744 32	$4,293 80	Mileage	$3,956 09	$1,500 30	Mileage	$483 70	0 72		$10,159 98	$41,450 21				Southern.
2																					
3																					
4																					
5																					
6																					
7		$2,630 65	5,630 00	6,398 01	2,586 92	569 18	401 44	24,582 69	Mileage, charge includes tracks, etc.				57 35	0 11	$10,454 92	4,619 26	57,830 43			458,368 50	Own.
8																		$530 00	40 cents per car mile		
9	818 75	871 67	1,080 00	2,040 40														545 33	25 cents per car mile 15 and 25 cents per car mile	10,000 00	Own. Official.
10																	3,886 44				
11	2,300 53	Foregoing Covers		1,521 38	234 60	325 00	173 74	1,335 58	Mileage		98 42		12 55	0 10		$28 26	6,080 37		25 cents per car mile.		Own.
12		868 56	44 02	7,140 85		900 94	562 25	3,631 06	Per car mile		2,480 28	Per car mile	596 19	1 4			26,680 85			98,000 00	Official.
13																					
14	2,200 00	13,414 49		18,501 22	588 00		650 57	9,618 45	Mileage		4,782 41	Mileage	3,000 00			19,391 84	79,331 12		Trip and mileage	300,000 00	Official
15	600 00	1,020 00		2,848 82	592 25	148 00	300 00	1,411 15	Per car mile, deducting power house labor		849 14	Car mileage	497 90	3 0		1,400 00	957 64	11,727 25	Per cent. of earnings	14,000 00	Iowa.
16																					
17			1,400 00																		Western Iowa.
18	1,020 00		4,800 00					4,800 00			5,216 92		374 64								
19													200 00	0 5							Official.
20			4,600 00																		
21	3,916 40	Foregoing Covers		4,181 64				928 02	4 cents per car mile.							5,270 75	14,296 00				Own
22																					
23																					
24	1,000 00		1,200 00	2,000 00	29,588 40	1,725 00		427 00	24,634 30	Estimated per car mile	3,771 45	Estimated from car mile	1,258 93		2,000 00		103,816 10	3,000 00	Estimated per cent. of wages		Own. Official
25																					
26	840 00		540 00	360 00	925 00		500 00	100 00	790 98	Actual cost	305 00	537 00	Mileage proportion	200 00	1 75		600 00	5,646 98		2,000 00	Own.
27																		1,540 37			Own.
28															1,030 00				25 cents per car		Illinois.
29				1,038 00			6 00			36 00											
30	360 00	1,965 85	240 00	6,412 86	1,200 00		91 06	2,525 75	24 cents per car mile.	2,022 85	See before	24 cents per car mile	301 70	1 01	186 30	2,971 37	597 22	19,538 84	22 cents per car mile.	25,000 00	Own.
31			312 72	1,500 00													19,538 84		Car mile and terminal charges.		Official.
32																					
33		3,706 24	1,200 00	3,274 41	5,845 72	211 95	209 73	726 43	24 cents per car mile	129 36	Included in rent of buildings, etc.		175 49	0 45	13,076 36	6,559 46	15,115 16			54,000 00	Official.
34																					
35	7 75		422 12	2,714 80	234 88	18 00	13 85	1,517 26	Mileage	638 90	1,027 71	Mileage				470 52	7,059 68			30,000 00	
36	1,973 00	2,818 95	2,300 00	6,338 69	1,816 33		655 57	2,666 06	Car mileage	2,376 15			150 46	0 35	10,008 45	16,635 77	51,748 33	14,241 45		100,000 00	Own
37	183 75		275 00	1,820 16	67 12		66 72	488 81	Car mileage	34 74			14 73	0 27		2,604 30	5,639 33	2,671 71		600 00	Official
38	694 00	43 54	1,884 75	3,677 52	250 03	71 30	612 99	2,791 89	Cost per car mile	1,033 85	6,167 90	15 cents per car mile	1,453 06		1,448 00	1,639 68	20,266 42			30,000 00	Official
39	587 70	16 76	4,022 76	2,782 62	1,110 71	25 00	505 80	1,510 06	Cost per car mile	756 41	4,150 85	15 cents per car mile	102 37		1,428 50	547 35	17,786 04	900 00	37 1/2 cents per car mile	10,000 00	Official and Own.

THAT BARBECUE

Those who attended last night's wild-game barbecue at White City—and between convention and local street-railway people there were three thousand of them or more—came away with unbounded admiration for the Denver City Tramway Company, which leased the entire park, with all its attractions, and fed the multitude with wild game just to show what true Western hospitality is like. The whole affair was a tremendous success, and all the officers and men of the company, from President William G. Evans and Vice-President John A. Beeler down, were received with acclamations wherever they appeared.

A slight sprinkle of rain caused apprehension early in the evening, but it soon ceased. The affair was held at beautiful Lakeside Park, which is illuminated with 98,000 electric incandescent lamps and contains a lake 75 acres in extent with a row of lights all the way around it. The visitors were formed in a long line—so long that the people at the head of it were fed and having fun about the grounds before those at the end reached the serving tables. As each man or woman passed down the tables he received a plate and was served with a portion of venison, another of buffalo, a third of elk and still another of bear. He was also given a grouse sandwich, a baked sweet potato, butter, condiments, a pickle for a relish and a piece of pumpkin pie.

The scene was picturesque. The servers were genuine cowmen, with revolvers in their belts, and occasionally one would fire his gun (loaded with blank cartridges, presumably) just for fun. The skins of the slaughtered animals hung about, and the long trenches in which the animals had been cooked showed evidence of their recent use. The servers were a frisky lot; the dignity of President Shaw and his associates didn't awe them a particle. "Come on, men," they cried; "here's your coyote, your wolf—gray, timber or prairie—your cat meat and dog meat. Right this way."

Provided with their food, the tenderfeet passed into a spacious pavilion, where there were hundreds of tables, and waitresses served rolls, with hot coffee or cider as beverages. Everything was amazingly good, cooked just right, and the experts explained to the uninitiated, who hadn't systematized in receiving their pieces of meat, just what each one was. After supper there was all kinds of fun—dancing, roller-skating, boating, shooting the chutes, taking the "third degree," riding on the scenic railway and the Lake Shore miniature railroad, and many other amusements. Music was furnished by the Denver City Tramway Band. The visitors possessed the park, and it was the convention carnival. Grotesquely dressed merry-Andrews added their antics to the lively scene. Later in the evening the cowmen gave a "broncho-busting" exhibition with four untamed horses, which added a touch of real excitement. It was a late, or early, hour before the last of the merry-makers left the park.

For this complete relief from convention responsibilities for a night every visitor felt deeply grateful to everybody connected with the Denver City Tramway Company. Perhaps no entertainment feature connected with a street-railway convention has been so thoroughly enjoyed.

A "wishbone" or "seeing-the-foothills" trip of 51 miles was the entertainment feature for the ladies yesterday afternoon. Special "sight-seeing" trolley cars, in charge of W. K. Beard and other members of the entertainment committee, took the ladies to Golden and, returning, left them at the barbecue, where the evening was spent as related above.

The Royal Gorge, 166 miles from Denver, forms the narrow mouth of the Grand Cañon of the Arkansas. The walls range from 1000 ft. to 3000 ft. in height and at one point the gorge narrows to a width of 30 ft. at the bottom.

CLAIM AGENTS' ASSOCIATION—CLOSING SESSION

The closing session of the Claim Agents' Association was called to order in the Metropole Hotel at 9:30 a. m. Wednesday.

Papers on the subject, "The Unreported Claim; Its Evils and Remedy," were read by C. A. Avant, claim agent, Birmingham (Ala.) Railway & Light Company; W. Robinson, claim agent, Cincinnati Traction Company, and W. O. Stout, general claim agent, Minneapolis Division, Twin City Rapid Transit Company. Following the reading of these three papers the members engaged in a full discussion of this vital subject.

Reports were received from the committees on employment and ways and means.

Election of Officers

The nominating committee presented the names of the following gentlemen to serve as officers of the association for the ensuing year:

President, E. C. Carpenter, claim adjuster, Indiana Union Traction, Anderson, Ind.

First vice-president, J. S. Harrison, claim agent, Jacksonville (Fla.) Electric Company.

Second vice-president, J. Handlon, general claim agent, United Railroads of San Francisco.

Third vice-president, H. K. Bennett, claim agent, Fitchburg & Leominster Street Railway, Fitchburg, Mass.

Secretary and treasurer, B. B. Davis, claim agent, Columbus (Ohio) Railway & Light Company.

These officers were unanimously elected, after which the new president, Mr. Carpenter, was escorted to the chair and made a short address. He was followed by the other new officers, who spoke briefly.

Appointment of Committees for 1910

The following members were appointed by President Carpenter to serve on the executive committee for the coming year:

J. R. Pratt, assistant general manager, United Railways & Electric Company, Baltimore, Md.

H. V. Drown, general claim agent, Public Service Railway, Newark, N. J.

E. R. Roberts, claim agent, Knoxville Railway & Light Company, Knoxville, Tenn.

W. P. Spillane, claim agent, Boston Elevated Railway, Boston, Mass.

The committee on employment appointed by the president consists of the following members:

William Tichenor, claim agent, Terre Haute, Indianapolis & Eastern Traction Company, Indianapolis, Ind.

C. A. Avant, claim agent, Birmingham (Ala.) Railway Company.

A. G. Mitten, claim agent, Chicago (Ill.) City Railway Company.

The committee on ways and means for 1910 includes:

S. W. Gonsalus, claim agent, Southwest Missouri Railroad, Webb City, Mo.

W. S. Heaton, claim agent, Pacific Electric Railway, Los Angeles, Calif.

A. E. Beck, claim agent, British Columbia Electric Railway, Vancouver, B. C.

B. F. Boynton, claim agent, Portland (Ore.) Railway & Light Company.

The committee on subjects for discussion at the 1910 convention consists of the following members:

H. V. Drown, claim agent, Public Service Railway, Newark, N. J.

W. P. Spillane, claim agent, Boston Elevated Railway, Boston, Mass.

C. B. Hardin, claim agent, United Railways of St. Louis, Mo.

General Business

A recess of 5 minutes was taken while the new executive committee retired to consider and adopt an amendment to the constitution making past presidents of the association ex-officio members of the executive committee. H. R. Gosborn, Philadelphia Rapid Transit Company, president in 1908, and C. B. Hardin, the retiring president, were therefore elected to the committee.

A plan was outlined at the conclusion of the meeting which will be submitted to the executive committee of the American Street & Interurban Railway Association for adoption. If the plan is adopted, it will assist every street railway company in the United States in detecting fake claimants. Under the proposed plan, the records of the index bureau will be kept on file in the office of the American Association in New York City, where they will be available for consultation at any time by member companies.

A vote of thanks was given to the retiring officers, to the daily press of Denver for the considerate and cautious reports printed of the meetings, and to the management of the Metropole Hotel for the use of the meeting room and the social dinner served in the banquet room of the hotel on Tuesday evening.

The meeting then adjourned.

TUESDAY MEETING OF THE TRANSPORTATION & TRAFFIC ASSOCIATION

(Continued from Page 728)

steam roads. He had to contend the other way, and produce facts that would bear out that contention. To do this he investigated the cost of power, among other things. At that time they were hauling their own coal a distance of 28 miles to their power house. The difference in rate from the mines to the power house, in comparison with the steam roads, was 25 cents in the company's favor, and the company was making 10 cents a ton, at a cost of 15 cents per ton for handling the coal. A power test of car consumption was made and the result was that today they find it cheaper to send the coal over the steam road and pay the railroad for hauling it. He thought next year the committee should go into the question of cost very carefully and, if possible, arrive at a basis by which to determine the cost.

H. S. Cooper, Galveston Electric Company, said that during the last six years, while Galveston has been under reconstruction, it has been necessary for the company to keep a motor car and five double-truck trailers merely for construction work. They had been trying to get at the cost of operating the cars. But although the cars have been in operation sometimes 12 to 18 hours a day steadily all the year round, the company has absolutely been unable as yet to determine on any basis as to what the operating cost was. They had tried to reduce it to a ton-mile or a car-mile basis, but had finally been obliged to make an arbitrary charge. They could get certain specific charges as regards employees, maintenance, repairs and renewals, but not as to the use of the track, overhead line, and even power.

Mr. Crafts thought it might be somewhat different on an interurban line.

F. I. Fuller, Portland (Ore.) Railway, Light & Power Company, said they had purchased a road which had a freight and passenger line about 40 miles long and another one 16 miles in length, which had a regular freight business. They had about 140 freight cars, and handle a great deal of timber, general merchandise and agricultural products. The cost between the freight and passenger business was divided on a car-mile basis, and he thought that a fair arrangement. The passenger cars run faster than the freight cars, but possibly average a little lighter. On this basis the freight operating expenses amounted to about 60 per cent.

The chairman then announced that owing to the small time left of the morning session the paper of Mr. Vaughan of Grand Rapids, Mich., would be read by title only. He then suggested that the committee on express and freight for the following year might go into the matter of operating expenses very carefully, and he hoped that the companies would respond freely and carefully to all questions which would be asked by the committee.

Report of City Rules Committee

President Allen then asked D. A. Hegarty of Little Rock, Ark., to submit the report of the committee on city rules. He also announced that Mr. Fuller of Portland would read a communication on this subject. This communication is published elsewhere in this issue. President Allen also read the following communications from E. E. Danforth, chairman of the committee, and J. L. Quackenbush, general attorney, Metropolitan Street Railway, New York.

Communication from R. E. Danforth, Chairman City Rules Committee

Sept. 29, 1909.

C. Loomis Allen, President,
American Street & Interurban Transportation & Traffic Association, Syracuse, N. Y.

Dear Sir:

The report of your committee on city rules, copy of which I herewith enclose, represents a great deal of earnest effort. In addition to the meetings held by the committee at the association headquarters, Engineering Societies building, New York City, on Mar. 27, June 7 and Aug. 27, a considerable portion of the committee work has been done by correspondence because of the difficulty of getting the widely separate members of the committee together at one point.

At the March meeting a general plan of work was outlined, each committeeman submitting to all the others his suggestions for additions, alterations and amendments to the existing code.

At the June meeting all members, having had ample opportunity to thoroughly canvass the proposed changes, a tentative code was drafted, printed and mailed to all member companies, a circular letter accompanying asking for criticism of the tentative code and suggestions for its improvement. Replies were received from a number of railway managers, nearly all being favorable to the code as drafted.

At the August meeting changes suggested by member companies, as well as by members of the committee, after legal advice, were carefully considered and a final draft of the committee's report was prepared for publication.

It is not claimed for this report that the rules are always expressed in the most elegant English, nor that the phrases are in every case strictly grammatical. The committee has, as far as possible, confined itself to the use of terms and expressions in a measure legalized by long usage in the street railway industry. It was not deemed advisable to make radical changes in the phraseology of a rule which had become thoroughly familiar.

A number of gentlemen have expressed their intention of discussing the report of the committee upon the floor of the convention, including H. S. Cooper, manager, Galveston Electric Company, who has prepared a very able and exhaustive analysis of the rules, together with timely suggestions on the subject. The other gentlemen are:

A. L. Kempster, superintendent of transportation, Seattle Electric Company.

Charles N. Black, vice-president and general manager, United Railroads of San Francisco.

C. B. Wells, Denver City Tramway Company.

F. W. Passailaigne, superintendent railway, Charleston Consolidated Railway, Gas & Electric Company, Charleston, S. C.

W. J. Kelley, general manager, Oakland Traction Company, Oakland, Calif.

F. I. Fuller, vice-president, Portland Railway, Light & Power Company, Portland, Ore.

W. A. Smith, Omaha & Council Bluffs Street Railway Company, Omaha, Neb.

You will note also comment of J. M. Quackenbush, general attorney, Metropolitan Street Railway Company, New York City. I would also call your attention to the general criticism of the rules contained in a letter addressed to you dated July 28, and attached thereto an attorney's comment thereon.

Believing that the above is sufficient to indicate the care with which the committee has performed its duty, and expressing the sincere regrets of the various members of the committee who have found it impossible to attend the convention at Denver, I am, Very respectfully,

(Signed) R. E. DANFORTH,
Chairman Committee on City Rules.

Communication of James L. Quackenbush, General Attorney, Metropolitan Street Railway, New York

As to the effect of such rules from the legal end of the business, I wish to advise that I have carefully read this book, and in my opinion, their adoption will not in the least affect the defense of cases. I desire to call your attention, nevertheless, to Rule 110, which refers to the assisting of elderly and feeble persons, etc., from the cars. It has been decided in our highest court in the case of Hanlon vs. Central Railroad Co., 187 N. Y. 73, that where you assist a passenger from a car you impose a duty upon the company of doing it carefully, and if the employee is careless and a passenger falls by such carelessness and is hurt, the company is liable. There is no duty which requires the assisting of passengers from the cars, so that this law has the effect of making the company liable for a gratuitous act. I, nevertheless, believe that as a business proposition the rule should be continued. Cases where the conductor would permit such persons as are inclined in the rule to fall while assisting them would be very few, whereas if such persons were not assisted they would in many instances fall and the reason given in court for such an accident would be defective steps, sudden starts, ice, etc., which would make a question of fact for the jury. It is hard to convince a jury that people fall without cause where the railroad company is the defendant and they would be inclined to show by their verdict that the company's servant should have assisted the passenger and avoided the accident.

It is not new to have cases decided by juries from the human standpoint rather than the legal. The omission of this rule from the book would not affect the liability if the conductor, nevertheless, assisted the passenger. To avoid the effect of the law it will be necessary to have a prohibition in the form of a rule to our employees not to assist passengers. This, I believe, would be unwise and if it became known would be harmful in the defense of suits.

President Allen then said that with the permission of the delegates, he would rule that amendments relating only to grammatical or typographical errors of the rules would not be considered in the discussion, but that they should be submitted to the 1910 committee for their consideration. The rules would be considered in sections, and amendments to them should be presented in writing.

The rules were considered in this way up to and including rule No. 123. Those upon which amendments were offered are given below and those amended are marked with an asterisk.

General notice*, 1, 2*, 5, 6, 10, 14, 18*, 21*, 22* (changed in position), 23, 26*, 27, 30, 33*, 101*, 103, 115* (omitted), 116*, 117*, 119*, 121.

The rules for motormen, beginning with 201, will be taken up this morning. The revised rules will be published in an early issue of the **Electric Railway Journal.**

The meeting adjourned about 1:15 p. m.

PRISON CARS IN BERLIN

Some years ago when the City of Berlin, Germany, wished to erect a jail for confining short-term prisoners in the suburb of Tegel, the latter municipality agreed to its construction only on condition that the prisoners should be brought in without attracting attention and that discharged inmates should not be released in Tegel. The police department settled this question by making a contract with the Grosse Berliner Strassenbahn whereby the street railway company furnishes a motor and crew to haul from one to three prison trailers every day between Berlin and Tegel. The cars were built by the police department and contain 30 cells each. As they are brought directly into the prisons at each end over special sidings, the public never sees the unwilling passengers. The entire run is 12 km (7.4 miles) and the street railway company receives 1 mark per car km or about 40 cents per car-mile for the service.

The Grosse Berliner Strassenbahn is seeking permission from the municipal authorities to increase the distance between specified stopping points from 250 m (820 ft.) to 300 m (985 ft.). This uniform spacing of stops is possible in Berlin as the stopping points are not fixed at cross-streets as in American cities. The Berlin practice has made it possible to attain schedule speeds up to 25 km (20 miles) an hour, which will be exceeded if the new proposal is approved.

RECENT DEVELOPMENTS IN RAILWAY MOTOR CONTROL*

By Clarence Renshaw, Westinghouse Electric & Manufacturing Company

The control of railway motors, as practised to-day, depends upon some half a dozen or more fundamental principles, such as the magnetic blow-out, the series-parallel connection, the power-operated switch with indirect control, and so on, and during the period which may reasonably be included in the scope of this paper, there have been no new developments of this sort for me to chronicle. In the perfecting of details and the production of new forms, sizes, and modifications of apparatus, however, many things of interest and importance have been done.

Unit Switch Control

The most important developments of the latter sort have been in the unit switch system of train control. Designed originally for elevated and electrified steam railroad service, this control has heretofore been made for use with automatic acceleration only, and with the power for operating the control circuits derived from a small storage battery on the car.

In this system of control it is only necessary for the motorman to place the handle of the master controller in the series or the parallel position and the switches will then close automatically, under the direction of a current-limit switch in the motor circuit, and cut out the resistance until the full series or full parallel position is reached. This effect is accomplished by making the master controller merely close the magnet valve circuit of the switches required for the first step, and arranging other circuits so that the closing of these switches establishes new circuits to the magnet valves of the switches for the second step, and so on, by means of auxiliary contacts or interlocks mounted on switches.

This system of control is remarkably simple, considering the results that it accomplishes. About 1,000 or more of these equipments are in use on a number of large roads throughout the country, where they are giving excellent satisfaction. Many operators, however, have hesitated in adopting the system for use on single cars or two-car trains, with equipments of moderate size, because of the apparent complications due to the automatic features, and on this account a much simpler form of unit switch control has recently been developed for use in such cases.

In the simplified form of unit switch control, the various connections between the motors and the resistances are made by means of seven or more (according to the size and number of the motors) pneumatically operated switches assembled together in a "switch group," and one pneumatically operated "reverser." Each switch is connected to the piston of a pneumatic cylinder, and normally held open by means of a powerful spring. The opening or closing of the switch is regulated by means of a magnet valve, connected to the cylinder, which admits compressed air when the circuit of the magnet is closed, and releases it when the circuit is broken. The reverser is moved to one or the other of its two positions by admitting air to one or the other of two cylinders similar to those on the switch group.

The supply of air for closing the switches is obtained from the main reservoir of the brake system, which is piped to an air chamber in the switch group, through suitable cocks and valves, together with an emergency storage tank for operating the car in case of failure of the compressor. The small amount of power which is required for operating the magnet valves is obtained from the trolley through a "control resistance," and its application is governed by a master controller at each end of the car. A direct wire from the magnet valve of each switch, or combination of switches, is carried to the master controllers, and these are so arranged that when the handle is moved to any notch, the circuit of the magnet valves of the several switches corresponding to that notch is closed and the switches are thus operated. By moving the master controller from notch to notch, therefore, the motorman starts and controls the motors in exactly the same way as with the ordinary hand-operated controller, except that instead of being mechanically connected to a revolving drum, located on the car platform and carrying the various contacts, the handle which he turns is connected by means of the magnet valves and pneumatic cylinders to much more powerful contacts close to the motors and underneath the car. It will be readily appreciated that such an arrangement is much simpler to understand than the automatic form, and as a matter of fact, the various circuits with this form of control can be as easily traced out as those of the ordinary drum-type controller.

The various circuits are carried to a multi-point train line receptacle at each end of the car, so that the circuits on two or more cars can be connected together by inserting a suitable jumper between adjacent receptacles, and the corresponding switches on each car can then be operated simultaneously by moving a single master controller.

Instead of the usual circuit breaker above the motorman's head, a small plunger is so arranged on the side of the switch group that when the current exceeds the desired amount the plunger is drawn in by the magnetic action of the blow-out coil at the end of the group, and by its movement opens the circuit to the magnet valves of the various switches, thus opening the switches. After having been opened in this way, the switches cannot be closed again until the master controller has first been returned to the "off" position. All of the main circuit contacts, therefore, corresponding to both controller and circuit breaker, are removed from the platform and located beneath the car.

The return of prosperity to the country after the recent period of depression is bringing to both city and interurban railway companies serious traffic problems which can best be solved by operating trains at certain times, instead of single cars. This matter was treated from an operating standpoint in a paper presented before the Transportation & Traffic Association last year by D. F. Carver, in which the advantages of train operation are clearly brought out.

Such trains could, of course, be made up of a motor car and a trailer, but at what expense to the equipment is indicated in the accompanying curve. This embodies the results of tests made by the writer a few years ago, and shows that the addition of a trailer (with the same seating capacity as the motor car, but somewhat lighter body and truck) for only one round trip of approximately one and one-half hours raised the temperature of the motors from its ordinary value of 75 deg. C. to about 100 deg. C., and that over two and one-half hours were required, after the removal of the trailer, for the motors to cool down again to the 75 deg. point. Had the trailer been kept in service for a longer period, it is probable that a temperature of at least 110 deg. C. would have been reached, in spite of the cool October weather during which the test was made. With multiple unit trains, consisting of two or more motor cars, however, the load on the equipment is even less when the cars are coupled in trains than it is when they are run singly, and it was with the idea of providing suitable apparatus, of the simplest and most reliable character possible, to enable such trains to be operated that the simplified form of unit switch control has been laid out.

Nearly all of the essential features of the switches, magnet valves, etc., employed in this form of unit switch control, are not new, but have been in use for a number of

*Abstract of paper presented as Section (L) of the report of the Committee on Equipment of the American Street & Interurban Railway Engineering Association, Denver, Colo., Oct. 4, 5, 6, 7 and 8, 1909.

years. We feel, however, that the simplification of the control circuits, and the general reduction in the number of parts required to make up a complete equipment, has now placed the apparatus on an entirely different basis, and opened up a new and wider field for its application than was ever before thought possible.

General experience shows that the introduction of a new method of accomplishing a given purpose always leads to improvements in the old method, rather than to its abandonment, as might be expected. As a result of this principle, the more common use of indirect control has led to various improvements and special features in the direct or hand-operated controllers.

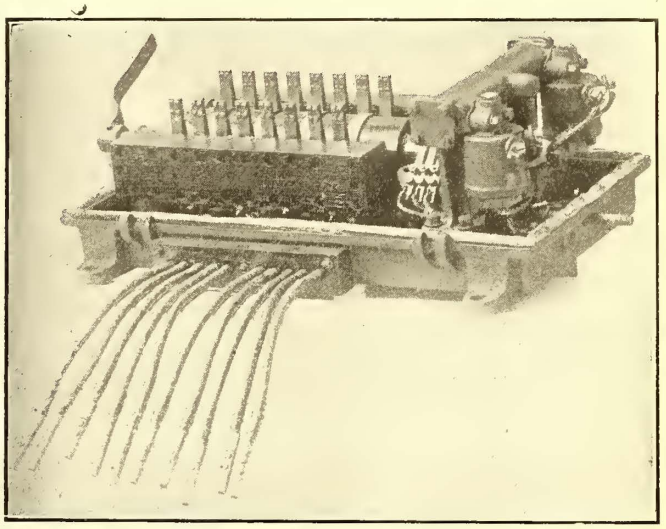
One of these improvements is the use of an auxiliary unit switch contactor in connection with the controller, for reinforcing and protecting it. To accomplish this purpose a single pneumatically operated switch is mounted beneath the car, and the circuit to its magnet valve closed or opened by means of a pair of auxiliary contacts, operated by the main controller drum.

Multiple Unit Operation with Hand-Operated Controllers

In cases where double motor equipments are used instead of quadruple, and especially with single-end cars, two-car multiple unit train operation may readily be arranged for with ordinary hand-operated controllers. To secure this, it is merely necessary to use a four-motor controller and resistance on the cars instead of a two-motor one, together with suitable receptacles and jumpers for connecting the two motors on the rear car to the controller on the forward one. When this is done the two-car train then consists of a standard quadruple equipment with two of the motors on one car, and two on another, or, to use a term which is now becoming common in connection with electric locomotives, the two-car train really consists of an "articulated" car.

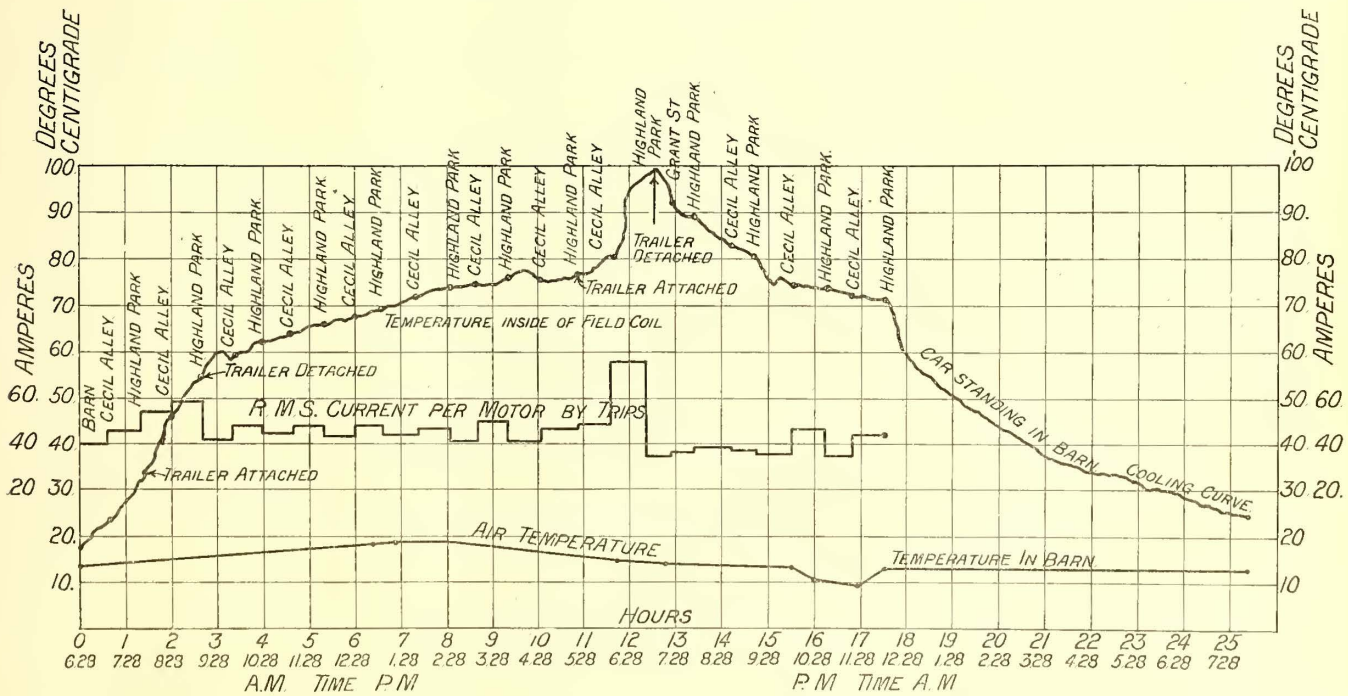
With double-end cars no simple arrangement can be made so that the cars will be interchangeable, but similar operation can be secured by providing a certain number of head-end cars and a similar number of rear-end cars, in which case only the former need have four-motor controllers. This latter arrangement, or one very similar to it, has been used in several places.

The use of a transformer on each car, from which any desired voltage, or number of voltages, for application to the motors can be easily obtained, makes the single-phase system as ideal from the control standpoint as it is from that of power supply. Variable connections from series to parallel are entirely unnecessary in this system, and the motors may be permanently connected in parallel, in series, or in series parallel, as desired, and simple and economical control secured by merely connecting them to different voltage taps on the transformer. Owing to the self-induction of such motors, also, which tends to minimize the current fluctuations, smooth acceleration can be secured with comparatively few notches, a total of five being usually sufficient even with equipments aggregating 400 hp or more.



Pneumatically Operated Reverser

All of these various control schemes as applied to different sizes of motors have been used in service on various roads, and all have been remarkably successful and satisfactory. As an instance of this, the master mechanic of one of the large single-phase roads stated not long ago that he believed he was having less than one-half of the trouble with his control apparatus than he would have had with hand-operated, direct-current controllers.



Curves Showing the Effect of Trail Car on Motor Equipment

HEAT-TREATED CARBON STEEL AXLES*

By J. S. Doyle, Superintendent Car Equipment, Interborough Rapid Transit Company

The following experiences with motor-car axle failures, together with some data and opinions collected for the purpose of correcting these failures, may be of interest:

The original motor-car axles installed on the Manhattan divison in 1902 have been in process of failure. Failure began at approximately 250,000 miles, and would have been complete at about 350,000 miles if not detected by inspection and removed. The filter stress was normal. The failure is characterized is "fatigue of metal," and in appearance is a "detail fracture," or a gradual separation of particles of steel. Standard locomotive driving-axle material was used on these motor cars, and although this material performs satisfactorily in steam railroad service, it has proved to be a failure in this and other electric traction service. The vibration set up in axle structures through the medium of the spur-gear method of power transmission may be the principal cause for these failures, which were detected by a system of inspection before breakage occurred, and the axles replaced by heat-treated material.

The use of heat-treated steel was decided upon after careful study of the subject, and, inasmuch as this feature of axle standardization has not been considered in the past, it is believed that the practice of the Interborough Rapid Transit Company, together with the data and technical opinions contained herein, may be of value to this committee in considering the advisability of adopting heat-treated materials for axles and shaftings performing arduous service. The specifications for heat-treated axles installed on the Manhattan division of the Interborough, it is believed, are rather rigid, and it was thought might prove too expensive and difficult of manufacture for general practice. A conference was held at the Engineering Societies Building on Thursday, July 22, 1909, for the purpose of obtaining a unanimous opinion on a form of specification that would best be suited to meet the general requirements of electric traction service on equipments with motors of 100 hp or more. The principal metallurgical engineers and representatives of the steel industries of this country attended the meeting and agreed upon a form of specification for heat-treated axles, and submitted a written opinion on the value of such materials, both of which are submitted herewith for your consideration.

A description of heat-treatment was contributed for the committee report by Dr. G. W. Sargent, of the Carpenter Steel Company.

W. P. Barba, of the Midvale Steel Company also contributed a rather full description of the manufacture and treatment of axles and shafts.

It should perhaps also be stated that wherever it is found necessary to improve carbon steel for use in gearing or for other purposes, the importance of the methods of heat-treatment should be borne in mind.

As previously stated, it was anticipated that the Interborough Rapid Transit Company's form of axle specification might possibly prove too rigid for general use, so it was considered advisable to hold a conference on this subject. The meeting was held at the association headquarters, Engineering Societies Building, New York City, and the following representatives were present:

George W. Sargent, Carpenter Steel Company; F. W. Weston and A. A. Stevenson, Standard Steel Company; W. A. Bostwick, Carnegie Steel Company; E. A. C. Acker, Bethlehem Steel Company; H. L. Waterman, Cambria Steel Company; R. Hitt, Electric Railway Journal; J. S. Doyle and Norman Litchfield, Interborough Rapid Transit Company.

The object of the meeting, it was explained, was to decide upon the development of a specification for heat-treated carbon-steel axles for use on electric motor cars equipped with motors of 100 hp or over, which would cover the material use in axles EC, EC-1 and ED-2 adopted as standards at the 1907 convention.

The following points were opened for discussion:

Process of Axle Manufacture

It is unanimously agreed that all axles for the class of service under discussion should be forged of open-hearth steel, either acid or basic, and that a treated axle is far superior to the untreated type. A heat-treated axle is one which is allowed to cool after forging, is then reheated to proper temperature, quenched in some medium, allowed to cool, and then re-heated to the proper temperature for annealing.

As to impurities, the maximum limit of phosphorus is to be 0.04 per cent for basic open-hearth steel and 0.05 per cent for acid open-hearth steel. It was agreed that the sulphur content affected the manufacturing processes only and was not deleterious to the consumer.

Messrs. Acker, Bostwick and Sargent all felt that 0.80 per cent would be a good maximum limit for manganese, Dr. Sargent stating that, in his opinion, this would give a stronger steel than one having a higher per cent. of carbon and lower percentage of manganese. (Compare recommendations of the American Society for Testing Materials.)

All present recommended not specifying the exact amount of discard and that the specifications should make this feature automatic. It was agreed that the specifications should read as follows: "Sufficient discard must be made from the top of the ingot to insure freedom from piping and undue segregation."

Physical Properties

After some little discussion all of the steel manufacturers present agreed that the following specifications would be satisfactory:

Tensile strength .....80,000 lb. per sq. in.
Yield point by drop of beam...45,000 lb. per sq. in.
Elongation in 2 in. .....22 per cent
Reduction of area .....40 per cent

In concluding this article the following original Manhattan motor-truck driving axle specification that failed in service is compared with the present Interborough specification and the recommended practice of the steel companies' engineers for a general specification for heavy electric traction service; also micro-photographs 4 and 5 of axle materials that have failed on large traction systems, together with the new heat-treated material manufactured in accordance with the Interborough Rapid Transit Company's latest specification, micro-photograph 6.

The comparison is as follows:

	SPECIFICATIONS.		
	Old Manhattan.	I. R. T. Co.	Proposed.
Carbon.....	0.40 to 0.55	As low as possible.	
Manganese.....	Not above 0.70	Not above 0.60	Not above 0.80
Phosphorus.....	Not above 0.05	Not above 0.04	Not above 0.04 for basic and 0.05 for acid.
Silicon.....	Not above 0.25.	.....	.....
Sulphur.....	Not above 0.04	Not above 0.04	Not above 0.06
Ult. strength, lb per sq. in.....	80,000...	....	80,000
Elastic limit, lb per sq. in.....	40,000	50,000	45,000
Elongation in 2-in., per cent...	20	22	22
Reduction in area, per cent.	....	45	40
Discard per ct..	30	30	Made automatic by location of test pieces.
Treatment.....	Slow-cooled by burying in dry ashes when hot from hammer.	Quenched in oil and annealed by reheating.	Quenched in some medium and annealed by reheating.
Location of test piece	Midway between center and outside.	Midway between center and outside.	Midway between center and outside.

*Abstract of paper presented as a part of the report of the Committee on Equipment, at the 1909 convention of the American Street & Interurban Railway Engineering Association, Denver, Colorado, Oct. 4, 5, 6, 7 and 8.

REPORT OF COMMITTEE ON EQUIPMENT*

By L. L. Smith, Chairman; J. S. Doyle, W. H. McAloney, L. W. Jacques, H. A. Benedict and M. V. Ayres

The scope of the committee's work for this year, having been enlarged owing to the rearrangement of committee work at the beginning of the year, embraces that covered by the former committees on maintenance and inspection of electrical equipment, control, and economical maintenance. Its duties also include suggesting to the committee on standards any new and appropriate standards or desirable changes in existing standards relating to equipment. Within this broad range of topics your committee has endeavored to cover the following subjects separately prepared:

(a) Economical Maintenance—By W. H. McAloney.

(b) Car Weights as Affecting Operating Costs—M. V. Ayres.

(c) Carbon Brushes—Compiled from data sheets by L. W. Jacques.

(d) Steel Tired vs. Rolled Steel Wheels—Compiled from data sheets by L. W. Jacques.

(e) Proposed Standards for Rolled Steel Wheels.

(f) Proposed Change of Flange Contour for Interurban Wheels.

(g) Proposed Gage for Mounting Car Wheels.

(h) Heat Treated Carbon Steel Axles—J. S. Doyle.

(i) Knife vs. Snap Switches for Car and Carhouse Light Circuits.

(j) Impregnation of Field Coils.

(k) 1200-Volt D. C. Car Equipment—Prepared at the request of the committee by F. E. Case, General Electric Company.

(l) Recent Developments in Railway Motor Control—Prepared at the request of the committee by Clarence Renshaw, Westinghouse Electric & Manufacturing Company.

(m) Conclusion.

(n) Appendix—Summary of Recommendations.

(a) Economical Maintenance

Economy avoids all waste and extravagance, and applies money to the best advantages. Any improved method that will reduce the time that cars are in the shop and increase the period of service is direct progress and economy.

The subject of arriving at a fair unit of work for a basis of comparing maintenance costs for such principal items as wheels, brakeshoes, bearings, carbon brushes, trolley wheels, armature and field coils, etc., on a basis of 1000 car miles, has frequently been advanced; however, it will be foreseen that variations in grades, curvatures, weights of equipment, speeds and real work accomplished make it difficult to arrive at a fair general unit. Yet if this could be arrived at through broad, concerted action and real facts covering a period of years, the recommended unit of value would no doubt be helpful in securing the highest grades of material and supplies and be of general value as a reference.

While it is presumed that most companies follow closely the association's standard method of accounting, yet variations in detail no doubt exist, and for this reason and because local surroundings and service conditions vary so extensively, the question of actual cost will not be taken up. Because this condition prevails and we recognize that gathering statistical data for comparison is prohibited, it has been very difficult to obtain material for the subject of this paper, and so definite recommendations are not warranted.

The Denver City Tramway operates about 200 miles of track, 50 miscellaneous work cars, sweepers, plows, etc., and 314 passenger cars, and for the purpose of calling attention to those items of material that involve the greater outlay of money in the three standard expense accounts, Nos. 6, 7 and 8, we have secured the total amount expended for material in dollars and cents during the year 1908 in the maintenance covered by these accounts, and under 31 classified headings show what proportion each classification bears to the total amount expended.

In making up this statement no allowance has been made for scrap recovered, and the proportion must therefore be considered as gross. It will readily be understood that had the amount of scrap recovered been secured and credited under the proper headings, the items showing the higher proportion—such as "brakeshoes," "magnet wire" and "wheels"—would, from the nature of their value as scrap, have received the greater credit; however, while in our records we charge "material and stores" with all material and scrap recovered, applying credit to the account against which it was originally charged, we find it difficult to obtain, and do not in all cases require, identification by name of original items comprising such scrap. These proportions to the gross total material used will serve to call attention to those items which require the greater outlay of money and which should call for a like proportion of consideration. While conditions vary in different localities, it is considered that these proportions to the total of gross material used as shown by the following statement will prevail to the extent that the figures will be of value.

Material Charges

Standard Accounts Nos. 6 and 8.	Pr. Ct.	Standard Account No. 7.	Pr. Ct.
Axles	2.04	Armature shafts, sleeves, and keys	0.26
Brake shoes	9.12	Bearings and babbitt metal	4.81
Brake appliances (all apparatus connected with brakes except shoes)	3.34	Brush holders and parts	1.28
Car trimmings	1.81	Commutators and parts	3.78
Drawbars and coupling pins	0.47	Controllers and parts	2.74
Fenders and parts	0.83	Fuse boxes, circuit breakers and lightning arresters	0.29
Glass	2.03	Gears	2.81
Gongs and bells	0.15	Gear cases and parts	2.15
Journal boxes and brasses	1.11	Insulating material (electrical varnishes, fibers, mica boards, etc.)	1.84
Lumber	1.69	Magnet wire, including armature and field	20.18
Paints, oils and varnishes	5.03	Pinions	2.45
Steel	1.34	Rheostats	1.87
Seat covering	0.06	Trolley poles and fittings	2.54
Springs	0.39	Wire (other than magnet wire)	0.54
Truck frame castings and forgings	1.33	Miscellaneous electrical supplies	1.55
Wheels (car)	15.23	Other material	2.26
Other material	2.68		
Total	48.65	Total	51.35

Brakeshoes

When it is realized that the outlay for brakeshoes is practically 10 per cent of that for all material used on a car, the importance of giving this one subject a great deal of attention is apparent. The question of securing from the original casting the maximum wear consistent with safety and a reasonable consideration for "pull-ins," is recognized as a very important factor in economy, and it is suggested that very close attention be given scrap shoes recovered, that they be weighed carefully and that each foreman in charge be advised of the proportion of wear that should be secured. In advising foremen of the results secured, it is suggested that each be furnished with a comparative statement giving the results from all houses. This will no doubt serve to stimulate competition and will tend to promote economy. To the end that the least amount of stock be carried and the greatest proportion of wear secured, it is strongly urged that the adoption of the association standard brakeshoes will prove economical.

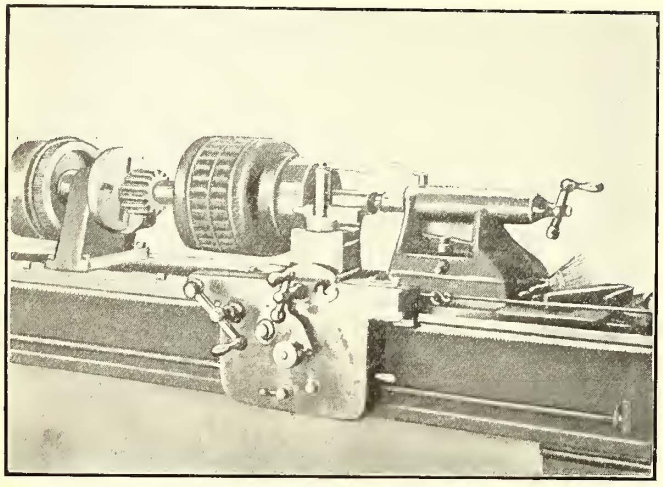
The great multiplicity of truck designs and the probable difficulty of getting manufacturers to agree, is no doubt the reason why the standardization committee has not recommended a distance from the rail at which the brakeshoe should be carried. It seems to be generally recognized that shoes on street car trucks have, in the past, been carried too low, and that especially where shoes are hung from the

*Abstract of report read before the American Street & Interurban Railway Engineering Association, at Denver, Colo., Oct. 4, 5, 6, 7 and 8, 1909.

frame adjustment is difficult for the varying loads; moreover, the proportion of scrap is greater than would be the case if the shoe were hung nearer to the horizontal center line of wheel.

As the time which the repairmen must give to this material is a considerable item, it is important that castings be clean and free from rough and uneven places, so that the least possible time is taken up in changing shoes; also, as brakeshoe mixture has a direct bearing on braking powers and on wheel wear, it is considered important that shoes be made by foundries making a specialty of this class of work.

This question is receiving a great deal of attention at present, and all are anxious to know of the best practical



Rolling Stock Equipment—Grooving Commutator on Lathe, Denver City Tramway

method of checking shoe wear and arriving at a unit cost. The following form is suggested for use in advising foremen of the percentage of shoe wear secured:

Brake Shoe Wear

Car house or Division	Number of shoes	Total wgt of original shoes	Total wgt of scrap shoes	Total wgt of metal worn	Per cent of metal worn

Braking pressure must vary directly with the weight of the car. Brakeshoe wear will vary directly as the braking pressure and the work accomplished, and therefore it is not considered as important for purposes of comparison to know the cost per 1000 car miles or ton miles, as it is to know the "per cent of metal worn." The following form is suggested for arriving at, as nearly as possible, the density of metal in shoes and the costs:

Wheel and Brake Shoe Test.

Wheel No.	Circumference of wheel	Circumference at end of test	Circumference wear	Original weight of shoe	Weight of scrap shoe	Per cent of metal worn

Total weight of new shoes at....per lb.....$
Total weight of scrap shoes recovered at....per lb. (scrap value) . . . .$
Net weight of shoes worn and cost.....$
Car mileage.. . . ..
Cost of shoes (8) per 1,000 car miles.....$
Kind of service....Weight of car....Schedule of speed....

Brake Appliances

Brake appliances which include shoe heads, pins, hangers, levers, chain, handles, staffs, ratchets, etc., on hand brakes, as well as all apparatus appertaining to air brakes, while amounting in outlay to only about one-third that of shoes, obviously are the most important features of a car and the more congested the traffic the greater the loss in all things if the brake and its operation is not modern.

To a very great extent it has become the practice to case harden all wearing parts of hangers, and where shoe heads are suspended by hangers, to bush the head when worn with case hardened steel tubing. It is also quite general practice to bush cylinder levers with case hardened steel tubing, and to case harden all brake rigging pins. This is an important factor in economy and is recommended for general practice.

As an example, the average malleable shoe head is worth when new about 48 cents, and when worn (if the beam is suspended from the head by the hanger) can be redrilled and bushed with case-hardened steel tubing at a cost of about 16 cents, or one-third the most of the head when new. It will then have a life possibly exceeding that of the original head.

Commutators

Commutators have an important bearing on expense. It is possible that the original size of commutators could be greater than it now is on many types of motors. This would result in a longer and safer period of wear before scrapping. To determine the limit of wear would be difficult, and no doubt it is often the case that in our eagerness to secure the longer life we frequently bring about other troubles more serious and expensive. The following table shows the types of motors in use in Denver with the original and the scrap diameters of commutators:

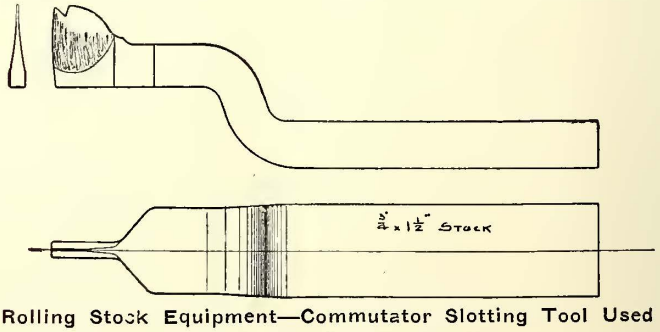
Type of Motor.	Commutator Dia. New.	Commutator Dia. Scrapped.	Remarks.
G. E. 53	12 in.	10¼ in.	Increased ¾ in. dia.
G. E. 58	10¾ in.	8½ in.	over factory size.
G. E. 800	10⅛ in.	7½ in.	Increased 1 in. dia.
W. P. 50	7 in.	5¼ in.	over factory size.
West. 101F	10⅛ in.	8 7/16 in.	
West. 3	8½ in.	6¾ in.	

Types of motors of an Eastern city, showing original and scrap diameter of commutators:

Type of Motor	Commutator Dia. New.	Commutator Dia. Scrapped.
G. E. 57	10¼ in.	8⅝ in.
G. E. 67	9⅛ in.	7⅛ in.
G. E. 74	11 3/16 in.	8¾ in.
G. E. 80	9⅝ in.	7¼ in.
G. E. 800	9⅛ in.	7¾ in.
G. E. 1000	8⅜ in.	6⅝ in.

It is suggested that the factory practice of machining, heating and pressing should be followed. A good mechanical commutator is an important factor in economy. Undercutting of mica commutator segments about 3/64 in. often increases the life of the commutator several hundred per cent, resulting in carbon brush economy, less carbon dust, etc., and a general reduction in troubles from "flashovers."

In the Denver shops commutators are slotted on a lathe which is also used for turning. The slotting tool is set at the proper depth and the stop is fastened to the slide rest of the lathe to insure a uniform depth of 1/15 in. in cutting



Rolling Stock Equipment—Commutator Slotting Tool Used by Denver City Tramway

the mica. The carriage is worked by the lead screw. The armature is left loose on the centers to take care of any untrue segments which are looked after by the operator. By this method commutators are slotted in the following time after having been set in the machine:

G. E. 53 armature, 99 bars, 12 to 15 minutes.
G. E. 58 armature, 99 bars, 12 to 15 minutes.
G. E. 800 armature, 105 bars, 15 to 20 minutes.
West. 101F armature, 111 bars, 20 to 25 minutes.

It is suggested as a good practice to slot commutators of all motors of over 25 hp capacity.

Control Apparatus

Control apparatus has been one of the weak parts of car equipment, but with the advent of the new K-34-5-6 type it is claimed by the manufacturers that considerably less trouble with platform controllers will be experienced.

In Denver, on the old K-6-10 and 11 types, we have reduced the troubles by being careful to get terminals on the blow-magnets as far as possible from the controller wires, and also we have reduced the number of blow-magnet burnouts by winding the coils with flat copper ribbon. This practice also shows an economy where burn-outs do occur, because repairs can be made by scrapping only a small portion of the coil.

The economy effected by the use of current limiting relays and grooving the commutator mica is shown in the accom-

	1907			1908			1909		
	Car Miles	Armatures Removed		Car Miles	Armatures Removed		Car Miles	Armatures Removed	
Feb..	128,443	33		140,333	15		170,917	17	
Mar..	141,575	27		152,510	17		182,265	14	
Apr..	147,051	36		150,599	18		192,380	20	
May..	142,695	36		162,693	18		211,418	11	
Total	559,764	132		606,135	68		756,980	62	
	Total Motor miles 4 months		Motor Miles per armature removed	Total Motor miles 4 months.		Motor Miles per armature removed	Total Motor miles 4 months.		Motor Miles per armature removed
	2,239,056	132	16,962	2,424,540	68	35,655	3,027,920	62	48,837

Rolling Stock Equipment—Table Showing Economy from Practice of Grooving Commutators

panying table for cars on the Chicago & Milwaukee Electric Railroad, which are equipped with 65-hp and 76-hp motors and multiple unit control.

During the summer and fall of 1907 current limiting relays were installed, all commutators were grooved and various minor improvements were introduced, resulting in a two-fold improvement in 1908, increasing to nearly three-fold in 1909. The operation of the relay is such that when a greater amount of current than the relay is set for is fed to the motors, the relay will open the master control circuit

of the contactors and cut the power off the motors until the controller is thrown off and speed again built up in the proper manner.

The current limiting relay recently used in Denver in K-10 type controllers is shown. The armature is pulled toward the star-wheel on the controller roll when the current limit is reached, thus checking any further feeding until the momentum of the car allows the current to drop, when a further advance of the controller is permitted. This current limiting relay is connected in series with the controller trolley finger.

Carbon Brushes

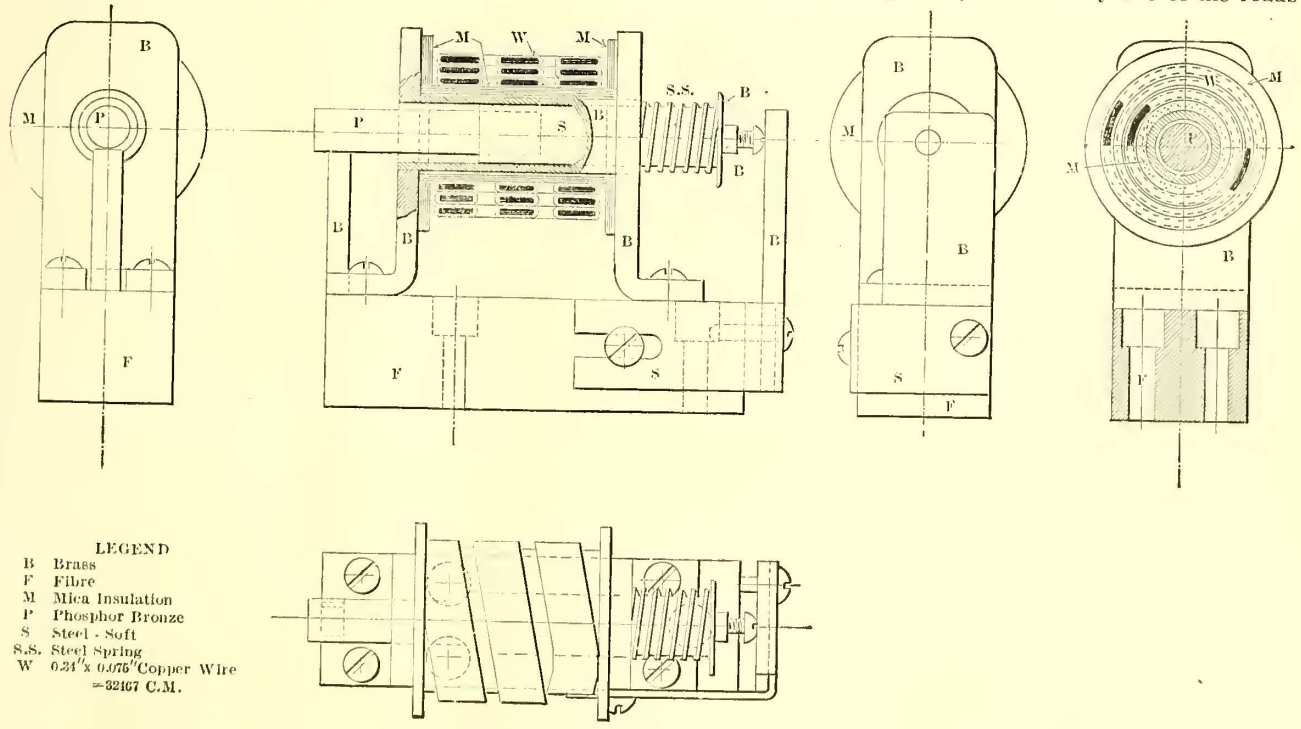
With the generally adopted method of slotting or grooving commutators and the use of higher grade brushes, troubles formerly experienced with carbon brushes have been reduced several hundred fold. The Fort Wayne & Wabash Valley Traction Company has a novel and economical scheme for utilizing large size brushes, where of uniform thickness, in motors using brushes of smaller dimensions. When a carbon has been used to its limit for the larger dimension, it is cut down by a substation attendant and then is used in a motor fitted with smaller brush-holders.

Painting and Cleaning Cars

Painting material is an important factor in car maintenance and in cities of moderate size where congestion has not reached the stage at which the further soliciting of business seems necessary, this part of the work must no doubt receive 5 per cent of the management's attention. On this question a quotation from a recent editorial in the **Electric Railway Journal** is worthy of notice: "The responsibility in car painting rests between the painter and the manufacturer. Good paint improperly applied gives no better results than poor paint, and even the best workman cannot get good results and long life from cheap and inferior mixtures."

The accompanying table, furnished by one of the roads in the Middle West, shows a saving both in time and money favorable to the method of using compound for cleaning cars preparatory to painting or revarnishing:

Cost of scrubbing the outside of an interurban car preparatory to revarnishing or repainting, including doors and vestibules:



LEGEND
B Brass
F Fibre
M Mica Insulation
P Phosphor Bronze
S Steel - Soft
S.S. Steel Spring
W 0.21" x 0.575" Copper Wire = 32167 C.M.

Rolling Stock Equipment—Current Limit Relay Used by the Denver City Tramway

	Not Using Compound.	Using Compound
Days required to scrub.....	3 Days.	2 Days.
Scrubbers' labor 120 hours @$0.17½..$21.00		
80 hours @$0.17½.....		$14.00
Compound: 3 gallons@$0.75		2.25

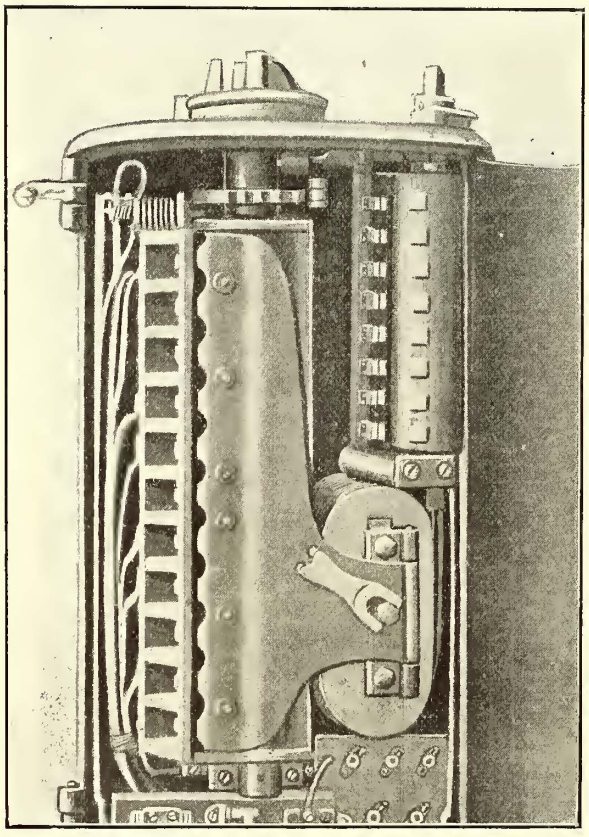
Economy per car in favor of Car Cleaner.

Cash.....	$4.75
Time.....	1 day
Other.....	Less damage to paint

The value of one day's time of a car out of service is perhaps anywhere from $2 to $20, depending upon cost and capacity of car and such local conditions as density of traffic and whether the railroad company possesses a shortage or surplus of available cars.

Magnet Wire

Magnet wire, which has the distinction of representing one-fifth of all the purchases for material used in maintenance of cars, continues to be one of the weakest items of material used. While conspicuous improvements have been made in many other directions, magnet wire, from the very nature of its delicate make-up, still calls for the closest inspection and the greatest of care in handling. Many cases of troubles and breakdowns yet owe their beginning to the weakness of insulation on wire. The report of last year's committee on maintenance and inspection showed very conclusively that the system of impregnating coils has grown in favor during the past two or three years and that economy has followed this method. It has also been demonstrated that immersing armatures that have exposed windings such as W. P. 50's., Westinghouse 12's and 68's, etc., and those of air compressor motors has proven decidedly beneficial.

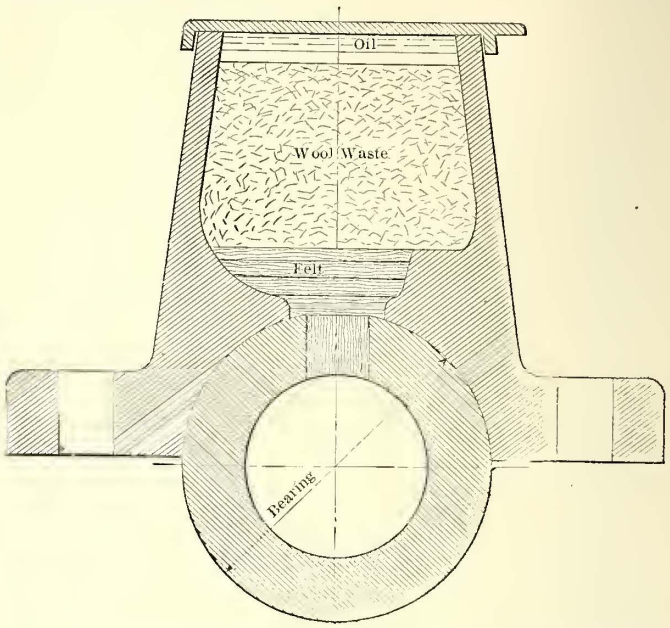


Rolling Stock Equipment—Current Limit Relay Installed in Controller Top

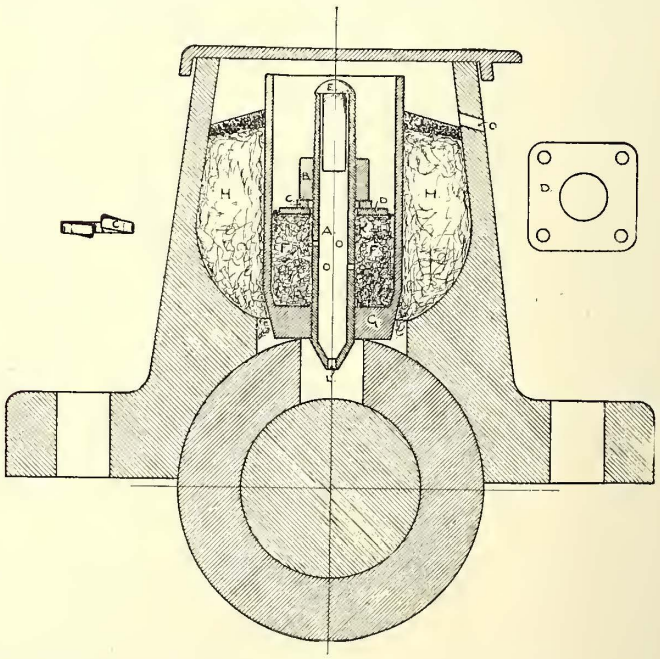
Trolley wheel economy has been obtained by using wheels 6 in. in diameter, and, after getting 3000 or 4000 miles wear, on interurban lines, placing them on cars in city service at slower speeds. In this way 6000 or 7000 miles of wear is secured, whereas it would only be possible to secure not more than 5000 miles in the faster service alone.

Lubrication

Lubrication has a direct bearing on expense, as unreliable methods seriously affect armature conditions. In last year's report of the committee on maintenance and inspection will be found some successful methods of applying oil to the older types of motors, originally intended for grease. In this paper two additional designs of oil cups used by the United Railways Company of St. Louis and the Denver City Tramway, are shown:



Rolling Stock Equipment—Oil Cup Used by United Railways of St. Louis



Rolling Stock Equipment—Oil Cup Used by the Denver City Tramway

The specifications for oil used are as follows:

Gravity.....	23½°	Beaumè
Flash.....	410°	Fahr.
Fire.....	480°	Fahr.
Cold.....	30°	Fahr.
Viscosity.....	420	

Wheels are shown to require an expenditure for main-

The cup used in Denver is made from a good grade of gray iron and put together as shown. Each individual cup is put on a testing rack with a cup known to be correct. A gas burner is placed between the two cups, so adjusted that when the temperature, close around the cup, is about 110 deg. Fahr. the oil will feed at the rate of one drop every 12 minutes. Whether fitting up new cups or testing old ones, this method is always followed.

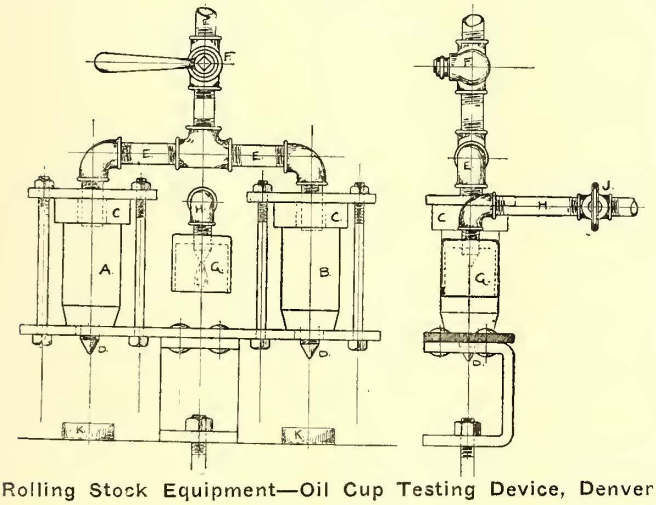
The rack with two cups on it and with an enclosed gas burner between them for regulating temperature, is shown.

Specification of oil used in the Denver cup is as follows:

Gravity	21.4° Beaumè
Flash	485° Fahr.
Cold test	35° Fahr.
Viscosity	149 at 212° Fahr.

With all oiling systems it is essential that the oil should run uniformly, but with the Denver type cup it is vital that the grade be uniform, especially as to gravity and viscosity. The Denver City Tramway Company has no laboratory, but on the test rack illustrated a sample cup is kept by which all other cups, new or old, are tested, and thus any great variation in oil can be detected.

It is poor policy to restrict any lubricating system in order to secure low costs for oil, because this saving will be



Rolling Stock Equipment—Oil Cup Testing Device, Denver City Tramway

secured at the expense of some other items. No doubt frequent so-called failures of lubrication are due to other causes; excessively hard work sometimes makes it impossible for any oiling system to keep its equipment out of trouble.

Wheels

Wheels which by the above statement are shown to call for an expenditure for maintenance material of more than 15 per cent of the total, and therefore offer a most important subject for study.

For city surface cars, up to the present time, cast chilled wheels have been most generally used, the rolled steel wheel probably not having been in use a sufficient length of time to demonstrate what service may be reasonably expected; however, with either kind of wheel the elements of careful manufacture rounded out with the most rigid inspection from the time material is charged in the cupola until it reaches its finished state, is vitally important.

As the energy stored in a rapidly moving, heavy car is absorbed in a few seconds through the wheel, by the use of the modern brake, brakes and wheels are commended seriously for consideration.

In mounting wheels it is important that great care be taken to see that the same tape sizes and shrinkages go on the same axle, and in the case of the two-motor equipments, it is no doubt equally important to see that the higher tape sizes be used as drivers. Only within the past year has the rule of using X to 3 tape for drivers and any wheel of lesser chill for idlers been closely followed. Results seem to more than warrant the trouble and extra care. Wheels with different shrinkages on the same axle no doubt are frequently the cause of the ever-present thick and thin flanges which sometimes are charged to the "out-of-square" truck. A large percentage of "slid flats" result from using the reverse when making emergency stops, and we would recommend as a feature of economy and the abolition of a public nuisance, that on all cars having power brakes, reversing of motors should not be resorted to except in case of defective brake rigging.

Inspection Work

Inspection work if slighted will cause serious interruption to traffic. Worn and flat trolley wheels cause arcing that burns the overhead wire; dry trolley wheel bearings cause cutting and shorten the life of the wheel; a pole put in with the wheel set at an angle causes the trolley to jump at the switches and may pull the trolley base off the car or pull the overhead wire down and, in addition to the damage caused, endangers life.

Poles not properly fastened in their bases may be the cause of accidents, and if the spring tension is weak it causes undue arcing and increases the wear on both wheel and wire. If a base is neglected and becomes dry, the trolley will run hard, causing jumping at switches and trouble without limit. Poor contact at the base causes the wire to burn off and means that a dead car must be pushed in off the line. Leaky roofs ruin car ceilings, are bad for seats and generally uncomfortable for passengers. Broken glass frequently is the cause of accidents. Bolts, nails and screws, if projecting from floor or any part of woodwork, sometimes result in torn clothes and falling passengers. Extended step treads sometimes strike vehicles, resulting in splinters and sharp edges and their accompanying dangers.

If cars are allowed to go into service with dirt or grease somewhere on the inside, the company may have to pay a bill.

Controller rolls, contacts and bearings if allowed to become dry will cut and cause short circuits; the roll will work hard and the motorman may not be able to tell distinctly whether or not he is stopping on the points; contact fingers may be set too low, and sometimes the set nut, if left loose on the adjusting screw, works out and the finger drops down and jams on the roll contact. Controller handles if neglected become worn and may not turn the roll to the last point, then running on the resistance, burning out a rheostat, and danger of fire may follow.

Oiling of motor bearings as well as car journals, when neglected, is probably the most expensive of all slighted inspection, because it causes the bearings to heat and the armature to go down on the pole pieces.

Motor terminals not being carefully inspected when connecting up is direct cause for broken wire in short time.

Bolts are left loose in the armature and axle caps; cotters are left out of bolts and hinge pins; brush holder hammers are left up; carbons are not cleaned and stick in their holders; weak springs; failure to tighten bolts and screws at yokes; oil and dust accumulated on brush holders and yokes until they short circuit and ground; neglect to oil and pack truck journals; brasses allowed to wear down, causing hot journals; and bolts in the trucks, when not kept tightened, wear face and holes so that later they cannot be kept tight. All these are points that must be carefully watched to insure the best results.

Brakes too tight frequently cause the loss of armatures, which may be laid at the door of the lubricating system. Improper adjustment and setting of shoes causes them to flange and lose a large per cent of their wear. Hangers worn and neglected cause brakes to shudder and chatter. Cotters left out of shoe-pins, and lever pins allowed to go without inspection may cause serious damage and accident. Leaks in the air system not discovered result in overwork-

ing the compressor. Neglected brake valves cause the seats to cut. Brake cylinders not cleaned and oiled, etc., and a thousand and one or more, little jobs, if neglected, are all serious, and many of them dangerous and have a direct bearing on expense. Quite a common practice among repair men is to patch up trouble and fail to give car and motors a careful inspection, so that further early trouble may be avoided. Lack of inspection is decidedly detrimental to best economy.

Education

The Bureau of the Census gives a total car mileage for all electric railways in the United States for the year ending Dec. 31, 1907, as 1,618,343,584, and gives for the year ending June 30, 1906, for steam roads, passenger train miles 479,037,553 and freight train miles 594,005,825, making a total of 1,073,043,378 train miles, showing the electric railway car miles for a year to exceed the total steam train miles (both freight and passenger) by 545,300,206. These figures are copied for the purpose of calling the attention of managers of electric railways to the millions and millions of details which must be worked out by probably millions of employees to produce the enormous mileage shown, such mileage naturally representing a corresponding volume of business and work.

Having called attention to a greater volume of work and an increased number of details beyond any suggestion of comparison, and fully realizing that our work calls for closer application than any other transportation work, it is strongly urged that more money and effort be expended in educational work.

[An article on "Car Weights as Affecting Operating Costs" presented as Section (b) of this report will be found elsewhere.—Eds.]

(c) Carbon Brushes

The data on carbon brushes have been compiled from data sheets sent out to the different street, interurban and elevated railroads and from answers to questions that were sent out to the manufacturers and engineering companies who have been interested in the performances of carbon brushes. A great improvement in the manufacture of motor carbons within the last year has been very noticeable. It is also noticeable that electric railways have given the matter of proper commutation considerable thought. The evidence of this is the extension of the practice of grooving commutators and the more general use of high grade carbons.

In answer to the questions submitted to the electric railways 64 of the data sheets were returned and most of those were from the larger companies that operate more than 100 cars.

Three stated that they had brush specifications. One larger company specifies, besides the dimensions, that carbons must have a carrying capacity of 100 amp per square inch of cross-section without heating, and that the coefficient of friction should be 0.2 at low speed and 0.3 at high speed. The second and third of these companies use the specifications recommended by the American Street & Interurban Railway Engineering Association last year. The balance of the companies answered "No."

One railway company gives the breaking test; 2 companies give the dimensional test; 21 companies give the service test; and the balance give no test whatever.

One company states that the manufacturer put 5 per cent of all carbons that are sold it through the test recommended by the association last year. One large company states that it has not as yet made a chatter-wheel as recommended by the association last year, but thinks that test is a long step in the right direction.

In regard to using a better grade of brush during the past year 32 companies answered that they had changed from a low grade to a high grade brush and found the results extremely satisfactory. Twenty-three companies have made no changes and the balance of the companies were still testing and had not as yet decided.

Seventy-five per cent of the companies stated that they were grooving their commutators, using a high grade brush and the average mileage was all the way from 15,050 to 43,000 miles. Practically all of the larger companies are using a high grade brush and grooving their commutators.

Twenty-three of the companies stated that they had noticed during the past year a decided improvement and a greater interest taken by the manufacturers in improving brushes. Twenty-three also had not noticed any improvement, but over 50 per cent of the companies are using a high grade brush of foreign make and state that these come very uniform and standard.

Seventeen of the larger companies state that they have obtained satisfactory results as to commutator and brush wear by grooving the commutators and by using a high grade brush, especially with the older types of motors. Several of the companies state that there is little commutator wear when using grooved commutators and soft high grade brushes, and that the brush tension can be reduced greatly by so doing. Several companies also called attention to the fact that a standard cannot be used on all types of motors, but that a series of tests should be made in order to determine the proper carbon that should be used with each type of motor. Two of the smaller companies are boiling their brushes in cylinder oil and are still using the old low grade brush. One large company states that it is better to use soft mica in commutator construction and the hard brush rather than groove the commutator.

Taking the reports of the companies collectively it is a noticeable fact that 75 per cent are following the recommendations of the American Street & Interurban Railway Engineering Association that were adopted last year; that there has been a decided improvement in brush quality, and that the railways have shown great interest in studying the subject of proper commutation. Many of the roads state that they have reduced their commutator and brush troubles 50 per cent during the last year.

Data on Carbon Brushes from the Manufacturer's Standpoint

A set of seperate questions was mailed to the different carbon brush manufacturers, that data might be obtained as regards specifications and the manufacture of carbon brushes for the several types of motors used both in city and high speed service. It would seem, according to all reports, that there can be no set specifications drawn that will cover all kinds of service. The conditions vary to such an extent that at the present time the only way to obtain a proper carbon for any motor is by making a running test. Certain conditions, such as the grooving of commutators, the hardness and thickness of mica used in the commutator, the speed, and the grades encountered, etc., are not always the same, therefore the specifications could not necessarily apply to all conditions. However, the manufacturers are always willing to meet these conditions, if explained to them by the railway companies, by sending several types of carbons for a running test for any motor, under any conditions.

In answer to a question regarding manufacturing improvements since the last convention, all of the American manufacturers answered that they had made many improvements, these consisting of changes in methods and processes of making that had eliminated to a great extent the segregation and shrinkage cracks that were formerly so common and that caused the breaking and chipping of the carbons, and consequently very poor commutation. Ingredients used have also undergone many changes and new mixtures have been added to make grades of carbons to meet the requirements of the different typs of motors oprated under the various conditions. Nearly all of the manufacturers are using the tests recommended last year by the American Street & Interurban Railway Engineering Association. The foreign

companies have made no change in the manufacture of their carbons, stating that they are standard.

Give specifications for a carbon brush to be used on a 100 hp to 125 hp motor with ungrooved commutator, in high speed service.

All of the companies agreed that the ingredients of a carbon for a 100 hp to 125 hp motor with ungrooved commutator in high speed service must be such as to give it the power to cut the mica insulation between the commutator bars and prevent high spots. The carbon should be hard, but not brittle; should be free from cracks and laminations, and should have a carrying capacity without heating of 125 amp per square inch of cross section on a running commutator.

In reply to questions 3, 4, 5, 6 and 7, in which the manufacturers were requested to give what they considered the best specifications for the various classes of service, the manufacturers stated that last year's specifications as proposed by the committee on maintenance and inspection of electrical equipment are entirely satisfactory.

The manufacturers did not seem to be able to state the increase in brush wear brought about by commutator grooving, but one of them gave an estimate that grooving increases the life of the carbon 12½ per cent. Several of the railway companies have expressed the opinion that it increases the life of the carbon at least from 25 to 100 per cent.

All stated that a test is given from their stock or from each lot of carbons manufactured and if the brushes do not stand this test the material is subject to re-burning or is scrapped, and all use the Association tests, which they approved and indorsed.

It is the opinion of the committee, arrived at from the study of data sheets submitted, that as a result of the stimulus given by the specifications of last year's committee and the standards set by a brush of foreign manufacture, the American manufacturers have so improved their product as to equal or excel any other made.

(d) Steel Tired vs. Rolled Steel Wheels.—Steel Tired Wheels

The information from which this report has been compiled was taken from data sheets sent to the different companies and from information received from the manufacturers. Data sheets returned on steel tired wheels show that many of the smaller roads are still using chilled cast wheels even in interurban service. It also shows that many of the larger companies are coming to the use of the rolled steel wheel, deeming it safer and more economical. One large company has entirely eliminated the use of steel-tired wheels and substituted rolled steel wheels. Thirty-five companies returned data sheets on the subject that could be used.

In answer to the questions submitted them, the data show that the average tire is about 3 in. thick and that they obtain about 2 in. wear. In doing this the wheels are given from two to four turnings and the approximate mileage between each turning is shown to average about 40,000 miles. Some roads allow the tires to run to a thickness of ⅞ in. before considering them unsafe, but the majority consider 1¼ in. as the limit of wear. It is noticeable that those who use ⅞ in. as a limit of wear have had considerable trouble with loose tires. This refers to fused tires with retaining rings and not to the bolted type.

Fifty companies returned data sheets on rolled steel wheels. The answers show that wheels vary in diameter from 30 in. to 37¼ in. New rims are from 2 in. to 3¾ in. thick. Some roads use them down to a limit of ¾ in., while others are using only to about 1½ in. This, however, is in the case of some of the smaller roads.

A great many state that rims were worn to a thickness of ¾ in. while several companies have a limit of ½ in. With the exception of a few smaller roads, the others use 1¼ in., the same as has been customary with the heavier type of steel tired wheel. The average shows that ¾ in. in thickness with the rolled steel wheel seems to be considered perfectly safe.

Three turnings are given by all roads except one of the larger companies, which gives 10 turnings. This large company gets 10,500 miles between each turning. The rest of the companies give their wheels from three to four turnings and obtain an average of about 30,000 to 35,000 miles between each turning. Nearly all stated that they find the last turning the softer and that they considered the rolled steel wheel the safer, and the majority thought it the more economical.

The diameters of the hub face which bears against collar of axle liner were given as follows:

For motors not over 45 hp, 9 in.; over 45 hp and less than 100 hp, 10 in, and 100 hp and over, 10½ in.

Rolled Steel Wheels vs. Steel Tired Wheels from the Manufacturer's Standpoint

A separate set of questions was sent to the several tire and wheel manufacturers, and questions and answers are as follows:

1.—Give specifications best suited for rolled steel wheels for street and interurban use.

One manufacturer gave the following formula:

Carbon	0.65 to 0.85 per cent
Manganese	0.60 to 0.90 per cent
Phosphorus	0.06 per cent
Silicon	0.15 to 0.35 per cent
Sulphur	0.05 per cent

2.—Describe the manner in which your wheels are rolled.

A long ingot is cast vertically, then sliced cold, and all segregation and shrinkage defects are discarded. The billet is then roughly pressed into shape under a 12,000-ton hydraulic press, which gives it a diameter from 6 in. to 10 in. less than the finished wheel. This blank therefore has all of the solidification defects, shrinkage, pipe, etc., entirely confined to the portion of the wheel occupied by the bore, out of which is then punched a piece weighing 18 lb. and upward, depending on the size of the wheel. A wheel so made is, therefore, very superior to one made from rolled steel, in which the pipe and segregation run through the wheel from face to face. This blank is then rolled in a specially constructed very heavy mill in which the work is done on the plate and rim, expanding the diameter and circumference until the finished section is obtained, the rim being entirely surrounded by rolls except the portion of the rim covered by the web. A second answer was similar to the above.

3.—Give thickness of web necessary for the several different diameters.

There was considerable variation in the answers to this question, but it would seem that from ¾ in. to ⅞ in. is the practice for street and interurban wheels. Approximately 1 in. is used for M. C. B. standards.

4.—Give approximate weights of the several different diameters, giving thickness and width of rims.

This was answered by the table of diameters and thicknesses of wheels and rims with the approximate weights as shown below:

Diam. of Wheel	Thickness of Rim.	Weights			
37 in.	3 in.	975	785	695	590
36 in.	2½ in.	875	710	625	540
34 in.	3 in.	900	715	630	540
33 in.	2½ in.	800	640	565	480
31 in,	3 in.	800	635	555	480
30 in.	2½ in.	700	570	500	425

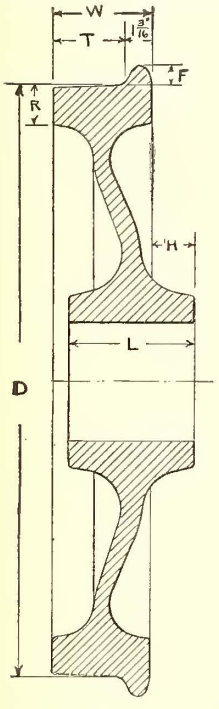
Answers to other questions were as follows in abstract: All companies stated that the material was homogeneous

throughout and contained somewhere between 0.65 and 0.85 per cent of carbon, but they all recommended about 0.70 per cent. It was stated that the rim of a rolled steel wheel could be made as homogeneous and even tempered as a steel tire. One company claimed that the rolled steel wheel was safer than the steel tired wheel. The interior flange bolted or riveted was considered the best fastening for steel tires.

Some manufacturers state that there is no difference and that both types of wheels can be worn practically to the same thickness, while others favor the rolled steel wheel.

Comparison of the Steel Tired Wheel with the Rolled Steel Wheel

Your committee does not believe it practicable at the present time to make any recommendations regarding which of the above types of wheels would be preferable, but de-



Rolled Steel Wheels Proposed Standard Sizes.

D	T	R	H	L
33"	2½" or 3"	2½"	1 15/16" or 2 15/16"	5½"
34"	2½", 3" or 3½"	3"	"	6"
35"	3" or 3½"	3"	"	6"
36"	3" or 3½"	2½"	"	6"
37"	3" or 3½"	3"	"	6"

Relation of Tread Width Total Width and Flange Height.

T	W	F
2½"	3 11/16"	¾"
3"	4 3/16"	⅞"
3½"	4 11/16"	⅞"

Rolling Stock Equipment—Rolled-Steel Wheels Recommended as Standard by Committee on Equipment

sires to call attention to a few of the facts as regards both types, which should lead to a lively discussion of the subject.

It would seem reasonable, especially from a safety standpoint, that a one-piece wheel would be preferred to a wheel made from several pieces or assembled sections. On the other hand, while the manufacturers contend that the rim of a rolled steel wheel is as homogeneous as a steel tire, the data, from the railroad companies shows that they find the last turning of these rims slightly softer than the first. It also shows that these rims can be worn to a greater amount with safety than can the steel tire.

The shop conditions in this case should also be taken into consideration, as many of the smaller roads are not equipped for removing and resetting the entire wheel, but can readily remove and reset a steel tire. Owing to the considerable amount of machine work that is required on steel tires, it would seem that the cost of a rolled steel wheel would not greatly exceed that of a steel tire, while the scrap value is all in favor of the rolled steel wheel.

It would seem that in the rolling of a tire the metal would be more homogeneous and evenly tempered throughout, as the rolling can be applied both to the inner and outer sections as well as to the sides, while with the rim of a rolled steel wheel this cannot be done. In comparing mileages, however, the data show that as to wearing qualities, the wheels are about equal and that the limit of wear of the rolled steel wheel rim can exceed that of a steel tire safely. This would offset the softness of the last turning, as before mentioned.

Shop Practice in the Maintenance of Wheels

In the maintenance of wheels, both for efficiency and economy, there are several points which might be considered which would increase the mileage or the life of the wheel. In selecting a pair of wheels to be mounted on an axle, the first thing to be taken into consideration is the diameter, in order that there may be as little variation in the wheels as possible. In boring the wheel, it should be bored absolutely true and it should be known that the axle is perfectly straight. The wheels after being pressed on should be gaged properly at several different points on their circumference so as to be absolutely certain that the flanges run true to the rail at all points. A gage should also be furnished the wheel inspectors whereby they could determine the exact wear of the tread and flange before the wheels are removed for returning.

It is very common practice for the interurban companies to allow the flanges to run until they are dangerously sharp. This is false economy, as, in this way so much metal has to be removed in turning to again bring the tread and flange to its proper shape, that the loss of metal is much greater than would be necessary were the wheels turned at the proper time.

Trucks should also be considered an important feature in the saving of wheel flanges. While from ordinary inspection it might appear that the truck was in fair condition, the placing of a tram diagonally across the truck from center to center of journal boxes will show a great many of them to be out of square. This also has a great deal to do with sharp flanges or the crowding of wheels.

Any of the above defects, to say nothing of bad track conditions, is an important factor in the life or mileage obtained from wheels.

(e) Proposed Standards for Rolled Steel Wheels

It is the belief of the wheel manufacturers, and of your committee, that certain representative dimensions of wheels can be adopted which will meet practically all requirements.

Manufacturers advise that much of the multiplicity of designs arises from differences in dimensions which are trivial for the most part and if the consumer had a proposition put to him in this way, by the manufacturers: "We can give you just the wheel you are ordering, but if you find yourself able to use an Association standard, which differs only slightly from your own, we will be able to sell this wheel to you for three or four dollars less per wheel than the one you call for," there is little doubt that the customer would waive any minor differences in size or design to take advantage of a pronounced economy.

A conference of wheel manufacturers was held in Chicago early in June, and the matter of standards was thoroughly discussed. This preliminary report was duly considered by the committee on equipment, and the committee recommends the sizes shown in the opposite column.

The fact that standard axles and standard height and thickness of flange as well as width of tread have been adopted by the Association simplifies materially the task of proposing standards for rolled wheels. There is nothing in the committee's recommendation which conflicts in any way with previously adopted standards of the Association, except that your committee suggests a change of flange contour which will be described in the next section of this report, but in either case the height and thickness of flange and width of tread remain the same.

(f) Proposed Flange Contour

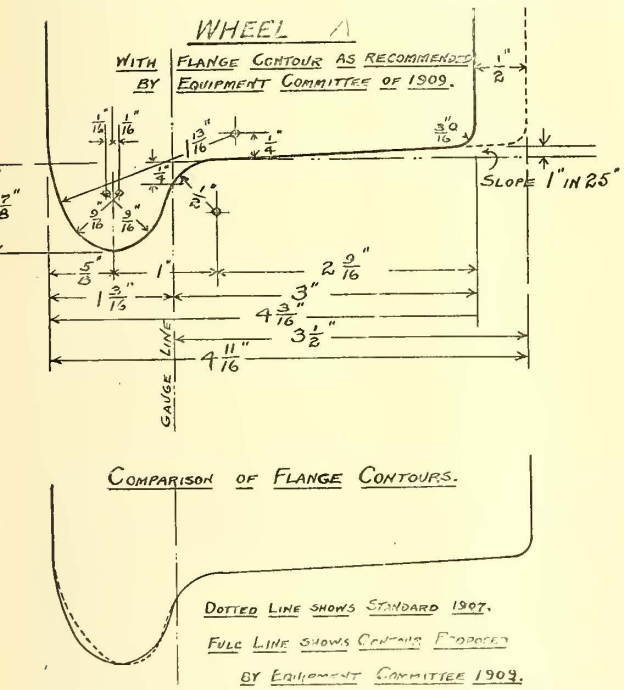
The standard flange and tread section adopted in 1907, wheel "A," shows a flange cut away on the outer face. This feature, your committee recognizes, may be necessary under certain conditions of city special work, but the general opin-

ion of both manufacturers and consumers, with whom this matter has been discussed, leads your committee to believe that a longer lived and more efficient flange can be secured. The flange section here shown is one which has given very good performance in actual service, and it is the opinion of your committee that this section will be found more satisfactory for the use of the average combined interurban and city road than the standard adopted in 1907, and hence this contour is respectfully submitted as a substitute for the one adopted in 1907. The diagram at the bottom of the illustration shows the relative shape of the two flanges.

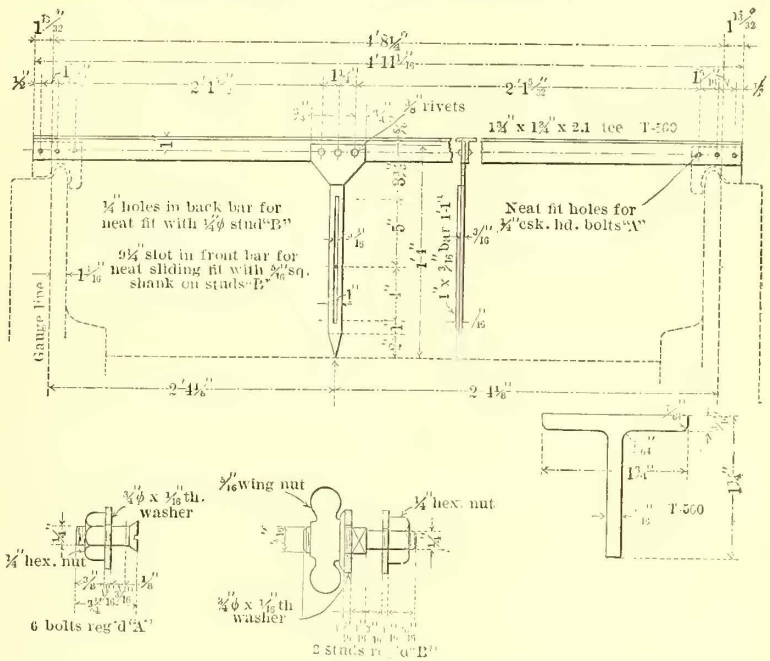
Your committee has no change to propose in wheel "B" adopted in 1907.

(g) Proposed Gage for Mounting Wheels

It is becoming recognized generally that where rapid wear of flange occurs, the rapidity of wear may not necessarily be due to any inherent defect in the wheel. If improper truck conditions exist, such as truck out of square, or truck not curving freely, these may produce bad flange wear. Also the same result may be experienced with mismated wheels



Rolling Stock Equipment—Flange Contour Recommended by Committee on Equipment



Rolling Stock Equipment—Gage Bar for Mounting Car Wheels

on the same axle, and from wheels not mounted centrally on the axle. In order to avoid this last condition it is proposed that a gage for mounting wheels will insure pressing the wheels on at exactly equal dimensions from the center of the axle be used. A good design of gage for mounting wheels is illustrated.

The center punch mark is made at the exact center of the axle, and as the first wheel is pressed on its location is proved up by the pointer with reference to the center punch mark. When the first wheel is properly located, the other can simply be mounted by reference to the mounting gage and flange of the wheel.

This gage for mounting wheels is proposed by your committee to be adopted by the Association as recommended practice.

[Section (h) on Heat-Treated Carbon Steel Axles, by J. S. Doyle is presented elsewhere.—Eds.]

(i) Knife vs. Snap Switches for Car and Car House Lighting

Letters of inquiry were sent out to manufacturers and insurance representatives and abstracts of their replies are as follows:

From the engineering department of a large electrical company: * * * "Except in the case of large cars where regular switchboards having slate or marble bases are used, the snap switches are much to be preferred for lighting and heating circuits, as compared with knife switches.

The same principle holds true in the case of car houses.

The above is true on account of the fact that knife switches for 600 volts have to be made with so long a distance between studs that unless a blade of very much heavier cross section than is necessary for carrying the current be employed, the switch is apt to be mechanically weak and flimsy. Thus, a 100-amp single-pole switch is about the smallest size that can be made with proper mechanical strength for such work, and a switch of this size is usually very much larger than the current requirements would call for.

Reliable snap switches can be made much more reasonable in size for 600-volt circuits, and, in addition to being covered and thus protected from accidental contact, are neater and less bulky.

A switch, the entire body of which is made of porcelain, offers an advantage over a metal-covered snap switch from the fact that there is no danger of the operator receiving a shock due to the switch becoming grounded in any way. On locomotives we had considerable trouble with metal-covered snap switches from this cause, and the engineers were subjected to considerable annoyance by receiving shocks from the switches. This difficulty was overcome by the use of porcelain cased switches which have proven very satisfactory.

Other large electrical companies wrote substantially as above.

From a New York underwriter's representative:

* * * We have had a great deal of trouble with snap switches owing to the fact that they are made too flimsy, and there has not been enough separation between the live parts.

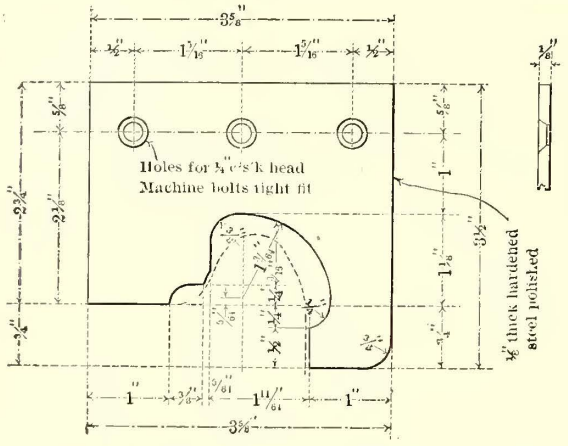
The mere fact that the parts of a switch are of sufficient proportions to carry the current necessary is a matter of little importance as compared with the amount of metal necessary for mechanical strength. These switches are used so continuously that the strongest we can get is none too strong for our purpose. Then, too, they are frequently misused by being so carelessly handled that their life is shortened.

The light flimsy construction of various snap switches, has, in the past, been generally and justly criticised, and the same objection holds true of the smaller forms of the baby knife switch. One of the principal advantages of the porcelain enclosed snap switch is that the live parts are protected. A great advantage of the knife over the snap switch is that the observer can tell at a glance whether the circuit is open or closed. It is evident that manufacturers of

switches realize that a more rugged and serviceable construction is demanded, and your committee is informed that designs of snap switches are being brought out to effect a material improvement in these respects.

Pending the service demonstration of the merits of these new designs no general recommendation on one form as against another will be made, but your committee would urge that designs of snap switches are being brought out to effect a material improvement in these respects.

Pending the service demonstration of the merits of these new designs no general recommendation on one form as against another will be made, but your committee would urge that in designs of porcelain enclosed snap switches the indication off and on be made as prominent and as nearly unmistakable as possible.



Rolling Stock Equipment—Gage for Use with Gage Bar in Mounting Car Wheels

(j) Impregnation of Field Coils

The committee on maintenance and inspection of electrical equipment in 1907 recommended that all field coils be impregnated with solid compound. The following year the same committee ascertained, by data sheets, that the attitude of member companies toward the process was as follows:

7¼ per cent approve and follow to full extent.
40 per cent approve and follow partially.
31½ per cent approve but do not follow.
1¼ per cent do not approve.
15 per cent are non-committal.
5 per cent are experimenting.

Instead of sending out data sheets on the subject of impregnation of coils, your committee, this year, has written to various railways using this process, and they are unanimous in their approval of impregnated field coils both for new and second-hand coils.

One large Eastern company that operates its own impregnating plant writes as follows:

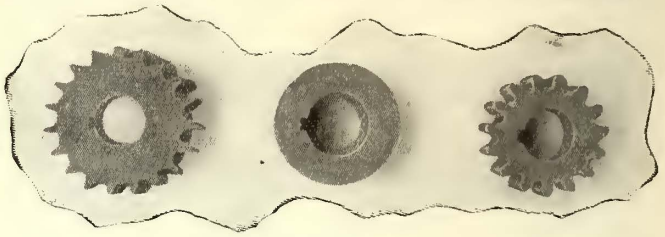
> We have had an impregnating plant in use for the past two years, and it is used only in connection with field coil work, as we have been unable up to the present time to find a compound that would stay in armature coils. During the years 1905 and 1906 we purchased for field work 109,700 lb. of copper wire. This was before we had installed the impregnating plant. For the years 1907 and 1908 we purchased 2143 lb. This is during the two years that we have had the impregnating plant in use.

Your committee wishes to re-affirm the recommendation of previous years in favor of impregnating, both for new and second-hand field coils.

[Section (k) on the 1200-Volt D. C. Car Equipment, by F. E. Case, engineer of railway equipment, General Electric Company; and Section (l), Recent Developments in Railway Motor Control, by Clarence Renshaw, Westinghouse Electric & Manufacturing Company, will be found elsewhere.—Eds.]

RECUTTING PINIONS IN DENVER

The accompanying illustration showing the three stages in recutting a railway motor pinion as done in the shops of the Denver City Tramway Company is presented through the courtesy of W. H. McAloney, superintendent of rolling stock. A 19-tooth steel pinion which has been worn out in service is shown. The middle view shows the same pinion after

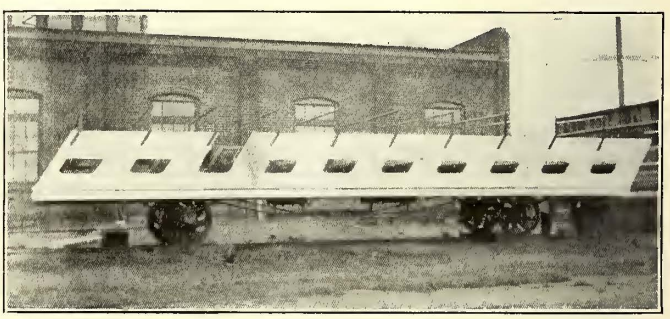


Denver City Tramway—Three Stages in Recutting a New Pinion from an Old One

the wornout teeth have been machined off, and a third view shows a new pinion which has been cut and finished on a milling machine, using the body of the old pinion as the blank. The small pinion cut from the old one has 15 teeth. Mr. McAloney states that the cost for recutting pinions is 90 cents, a small amount when compared with the original cost of a new 15-tooth pinion, which is given as $2.24.

CARS FOR MT. MORRISON CABLE RAILWAY

Ten miles west of Denver a cable road is being constructed up the steep side of Mt. Morrison. From the summit of this road a magnificent view of the Rocky Mountains to the west and the plains of Colorado to the east may be had. The construction of the roadbed up the side of the mountain which, in some places has a rise of 70 ft. in 100 ft., has called for careful engineering work. Passengers will be



Open Car for Mt. Morrison Cable Road

carried up and down this incline cable road in two large open cars, one of which is illustrated. These cars, it will be noted, are provided with cross seats built in an inclined position so that they may be easier to sit upon when the car is negotiating the steep grades. These cars were built by the Woeber Carriage Company of Denver, and will be operatd through the medium of a cable with one car at either end, thus balancing the load.

The city and interurban carmen of the Detroit United Railway who have been in service for two years or more have received voluntary increases in wages as follows: Two year men from 24 cents to 25 cents an hour; three year men or over, 25 cents to 27 cents an hour. The one year men will continue to receive 23 cents an hour as heretofore.

John S. Kennedy, secretary of the Public Service Commission of New York, Second District, contributed to the Saturday Evening Post of Sept. 25, 1909, an article on the work of the commission, entitled "Safe-Guarding the Public Services."

Among the Exhibits

The attention of those interested in overhead line equipment is called to Spaces 624-626, where the Electric Railway Equipment Company has on exhibit its Universal hangers. This is a new device which greatly simplifies overhead construction.

* * *

At Space 620 can be seen the reason why the Denver City Tramway Company has treated 200,000 ties with the "C. A." wood preserver. A number of sample treated ties were taken from a piece of track in Denver, and presented to the "C. A." Wood Preserver Company of Austin, Tex., for this exhibit.

* * *

The Vacuum Car Ventilating Company, Chicago, Ill., is represented at the convention by D. T. Cooke, the patentee of the system of ventilation which the company has just placed on the market. The company has recently received an order from the Chicago Railways Company for equipping 350 of its P-A-Y-E cars with this system of ventilation.

* * *

The Western Lumber & Pole Company, Denver, Colo., has an exhibit in Space 701. The name of this company did not appear in the list of exhibitors as published in the **Electric Railway Journal** for Oct. 5, 1909. B. F. Vreeland, W. H. Lewis and M. G. Graft, representing the Western Lumber & Pole Company, are showing genuine Idaho cedar poles, treated fir ties and paving blocks.

* * *

The Railway Materials Company, Chicago, Ill., has no exhibit at the convention this year but is represented by F. C. Folsom. This company manufactures brake shoes and has recently placed on the market the RYMCO automatic high-speed trolley switch for interurban railways. This switch is a mechanical device operated in unison with the track switch which when desired automatically shifts the trolley wheel from the main line wire to the siding wire. During the past six months this switch has been adopted for use on more than 25 high-speed interurban lines.

* * *

John F. Scott Company, Highland Park, Ill., shows in Space 723 the Scott combination hanger and ear and other line material. Mr. Scott was formerly superintendent of construction for the Chicago & Milwaukee Electric Railroad Company and is a man of wide practical experience. His combination hanger and ear is a single casting taking the place of the old-style separate hanger and separate ear connected with a bolt, thus replacing the two-piece or three-piece suspension by a single casting. The device is composed largely of copper and has been tried out successfully for over seven years in high-speed interurban service. Mr. Scott also shows the H. B. Clarke section breaker skate. This device is said to more than double the life of the circuit breaker, due to the fact that the skate has a flexible end to take care of all line motion. This device is made from an alloy consisting of 85 per cent copper.

* * *

The Ohio Brass Company occupies Spaces 47-59 inclusive, and is exhibiting its overhead trolley fixtures including those used for catenary construction, "One Piece" rail bonds, third-rail insulators and high-tension insulators. Of particular interest is its electrically-illuminated classification and marker system shown in operation. The new No. 1 Tomlinson coupler for city service is shown in operation and in such a manner as to demonstrate its intercoupling features. The Tomlinson M.C.B. automatic coupler is also shown. Pneumatic sanders are shown in operation and in the high-tension insulator portion of the exhibit is shown the 110,000-volt suspended type of insulator as used by the Hydro-Electric Power Commission of Toronto, Ont. This insulator was adopted as standard by the power commission after an exhaustive series of insulator investigations were conducted. A model of the tower as used on this notable transmission system is also on exhibition. An automobile carrying pennants displaying the Ohio Brass Company's monogram in orange and black is at the entrance to convey delegates to and from their respective hotels.

* * *

Meyer Safety Guard Company is demonstrating the prevention of boarding and alighting accidents, on all types of cars, through the use of its safety guard. Street railway men from all over the country are investigating this invention and it is said a number of companies are considering the adoption of this device.

* * *

The Automatic Fusible Lightning Arrester Company has an interesting exhibit in its booth at the south end of the annex. This arrester is practically designed for trolley line and feeder protection and has established a unique record for protection in Colorado Springs, where electric storms are very severe and where cars have been stopped during storms.

* * *

George Wilson of Pasadena Cal., has on exhibition at booth 401 in the main Auditorium a model of the Wilson continuous rail joint. The outer plate of the joint is rolled to fit flush with the tread of the rail at the top and extend under the base. The outer plate serves as a rider over the joint by means of which the wheel is carried over the joint without the usual hammering. The inner plate connects with the lower part of the outer plate and thereby assures a perfect alignment of the rail ends.

* * *

The American Wood Preserving Company, Chicago, Ill., Space 245, is distributing copies of the analysis of "Antiseptine," which is an improved carbolineum-type of wood preservative. According to the analysis made by Prof. Gellert Alleman of Swarthmore College, "Antiseptine" is shown to be more powerful and permanent than any other preservative now on the market. The company guarantees that all shipments will conform strictly to specifications. The company is represented at the convention by J. R. Bird and H. W. Weihe.

* * *

The Allen street railway switch, now on exhibition in Section 719, is attracting wide attention on account of its simplicity and adaptability for the work intended. It is automatic, operated by the motorman from the vestibule by foot pressure. The pressure may be applied 10 or 15 ft. before reaching the switch plate, which is in the center of the track on the ground level and distant from the switch rail 15 ft. or more. The advantages claimed for this device are that there is no apparent friction or grinding sound, no expensive outlay and no maintenance expense; no machinery to protect from dir; that it will work under all conditions. If a car on the track is not provided with the switch-throwing device the switch can be thrown with a switch rod in the old way. A. B. Allen, the inventor, lives in Pueblo.

* * *

The Nichols Street Car Signal Company is exhibiting a working model of its signal in Space 417 and also on the pay-as-you-enter cars in Spaces 180 and 184. A sample is also shown at the Western Electric Spaces, 118-124. This new signal is devised to save life and prevent injury to persons, and it appeals both to the layman and the practical street railway man. It is intended to prevent accidents caused to pedestrians passing back of one car, but in front of another approaching on a parallel track. An electric gong placed on the rear dash, operated by the motorman from trolley current, gives alarm when a car is approaching on the other track. Electric lights are used with the gong and illuminate words of warning at night. The signal is positive in opera-

tion, and the inventor believes that it cannot fail to answer the purpose for which it is intended.

* * *

The Star Brass Works of Kalamazoo are exhibiting their well-known line of trolley wheels and harps.

* * *

F. N. Root of Kalamazoo, Mich., is showing Root track scrapers at the booth of the Star Brass Works.

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J. R. Wiley is the only representative in Denver for the Standard Underground Cable Company, Pittsburgh, Pa.

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H. A. Corell, Buffalo, N. Y., representing the Corell Railroad Tie Company, Mt. Jewett, Pa., spent Wednesday at the convention.

* * *

A. A. Wagner and E. D. Batchelor are attending the convention in the interests of the Jones & Laughlin Steel Company, Pittsburgh, Pa.

* * *

Harold J. Wrape of the American Carbon & Battery Company, East St. Louis, Ill., has headquarters at the Standish Hotel. His company is not exhibiting this year.

* * *

The American Car & Foundry Company has no exhibit but is represented at the convention by C. P. Dickerman, W. C. Dickerman, W. A. Williams and Thomas Plunkett.

* * *

The Hudson & Manhattan Railroad, New York, is continuing to order Karbolith car flooring of the American Mason Safety Tread Company, specifying a carborundum-sprinkled surface.

* * *

The Baldwin Locomotive Works, Philadelphia, Pa., is represented by C. F. Dodson, Charles Riddell and Carl H. Peterson, who are making their headquarters in the booth of the Standard Steel Works Company.

* * *

The Wheel Truing Brake Shoe Company of Detroit, located in Space 22[illegible], reports that a good deal of interest is being shown in its abrasive shoes, which are adapted for service on both chilled iron and steel wheels.

* * *

The interests of the Niles Car & Manufacturing Company, Niles, Ohio, are being looked after at the convention by J. A. Hanna, sales manager, and F. C. Robbins. This company makes a specialty of large interurban cars.

* * *

For the first time in several years the Joseph Dixon Crucible Company, Jersey City, N. J., is not making an exhibit at the convention. The company, however, is represented at Denver by its St. Louis representative, Charles D. McIntosh.

* * *

E. H. Sniffin, second vice-president and head of the sales department of the Westinghouse Machine Company, is attending the convention in the interests of his company. Mr. Sniffin is known among electric railway men from Maine to California.

* * *

F. F. Stockwell and H. R. Luther of the Barbour-Stockwell Company, Boston, Mass., arrived on Monday to attend the convention. Although they have no exhibit, there will not be many railway men to whom they will fail to extend their cordial greeting.

* * *

The Tool Steel Gear & Pinion Company is showing a number of specimens of its hardened steel motor gears and pinions. These products are made of an extra grade of steel and it is claimed are practically indestructible.

The representatives of the Electric Storage Battery Company, Philadelphia, Pa., are making their headquarters at the Savoy Hotel. The party includes Godfrey H. Atkin, manager of Chicago office; H. B. Marshall, St. Louis office; George H. Morris and R. L. Lunt.

* * *

The Wyoming Yarn Company, New York, is showing at Booth 514 samples of its Wypak journal packings. This is an all-wool product that retains the oil in the journal box and properly lubricates the bearing. The company is represented at the convention by E. M. Tillinghast.

* * *

The Nachod Signal Company of Philadelphia is showing its Type C signal for trolley roads by means of a miniature track plan connected up to a pair of signal boxes. This demonstration is eliciting a good deal of interest, as any operating condition can be produced and the effect immediately noted.

* * *

Delegates attending the convention have an opportunity to look into the merits of the Rooke system of fare collection at Space 140. The Rooke automatic fare collector and the Rooke fare box for pay-as-you-enter cars are there on exhibition with R. S. Rooke in attendance to explain their operation.

* * *

The Electric Service Supplies Company is showing as part of its exhibit in Spaces 270-276 and 321-327, a new type of automotoneer. A number of improvements have been made in this device which will be found of interest. This company has recently completely equipped some of the largest railway systems with the automotoneer.

* * *

A railway crossing alarm is shown at the American District Telegraph office in the basement of the Colorado Telephone building. This alarm is noteworthy on account of its simplicity and low price. It ceases to ring when the train is on the crossing. Mr. Alexander, the inventor, is on hand to explain the workings of this new device.

* * *

As usual, the booth of the Taylor Electric Truck Company, Troy, N. Y., is a center of interest to railway men. Photographs of over 30 types of trucks are shown as well as photographs of springs and wheels. This company manufactures the Taylor malleable center steel-tired wheels known as T. M. C. wheels. The exhibit is in charge of John Taylor and C. H. Dodge.

* * *

For special use on cars where the regular style of tip does not permit the curtain to be raised sufficiently high, the Curtain Supply Company has designed a short tip fixture embodying the same principles and mechanism as the Forsyth No. 86 fixture, and is exhibiting it at the convention this year. This short tip fixture is especially desirable for use in connection with a narrow curtain box.

* * *

For several years past the Massachusetts Chemical Company has made a practice of distributing at the street railway conventions valuable souvenirs, and this year is no exception. The representatives of the company have announced that purchasing agents and master mechanics in attendance at the convention will find it a paying investment to visit the company's booth, No. 114, in the Auditorium annex. The company's representatives state that its past record for giving souvenirs of value is being surpassed this year. A special invitation is extended to all railway men to visit the booth today.

* * *

The Standard Brake Shoe Company, located in Space 400, are represented by F. C. Peck and C. P. Wright, president.

Owing to the fact that every available foot of floor space in the company's roomy plant is at present filled with rush work it was impossible to get out a satisfactory line of sample brake shoes for the exhibit. Either Mr. Peck or Mr. Wright will be glad to give full information regarding their special mixture cast iron brake-shoes.

* * *

The Chicago Car Heating Company in Spaces 170-172 has an exhibit of a new hot-water heater in operation. This heater embodies a number of new features and it is claimed will reduce the fuel consumption 50 per cent. It also eliminates the annoyance of frequently refilling the heater system with water necessitated by frequent opening of safety valves to relieve the pressure. The system is also adapted to heating residences as well as cars. It is shown in operation and W. P. Cosper is in charge to explain any points.

* * *

E. W. Furbush, L. O. Duclos and A. E. Duclos are busy at Booth 114 explaining the merits of the various products manufactured by the Massachusetts Chemical Co. They have in charge a varied exhibit of insulating specialties, including Armalac insulating compound, Neponset, Walpole, No. "264," Norfolk, Re-insulating, and Dryfield insulating rubber and friction tapes; insulating paints, Enamelac, baking japan, asphaltum varnish; Neponset, Walpole and Union splicing; compound insulating cement, cable wax and filling compound.

* * *

McGuire-Cummings Manufacturing Company, Chicago, is distributing at the convention an attractive folder calling particular attention to the single and double-truck types of snow sweepers and snow plows manufactured by the company. The folder is several feet long when unfolded and contains besides half-tone illustrations of the various types of snow-handling cars, a list of the cities where its cars are in use and a few letters from railway officials who have had experience in fighting snow with this company's equipment.

* * *

The Avery Scale Company of North Milwaukee is demonstrating in Spaces 616-618 a patent automatic track scale for weighing coal or ashes in power houses, mines, gas works, etc. This scale automatically weighs and registers the number of loads passing over it. It shows the net weight of each load and integrates the net weighings for the day. The company also demonstrates an automatic continuous weigher for handling coal to boilers. The company is represented by N. C. Webster, manager, and Ben E. Ordway, southwest representative.

* * *

The representatives of the Buckeye Electric Company are busy this week explaining the value of tantalum lamps for street car lighting. This company has developed a metallic filament incandescent lamp which when connected in series for car lighting provides excellent interior illumination. It is claimed the lamps have an average life in service of 1700 hours and that their use makes it possible to save from $80 to $100 per year for every 1000 lamps installed. The company has equipped about 300 of the cars of the Denver City Tramway with these lamps.

* * *

Traffic managers insist that if you advertise a high-speed service you must maintain it. Bearing this fact in view it is interesting to note that a damaged pole or wheel may be changed in 20 seconds by using the high-speed trolley equipment exhibited by the Bayonet Trolley Harp Company of Springfield, Ohio. This prevents loss of time and obviates accidents. Mechanical men also will be interested in the Bayonet line of self-lubricating wheels and axles. No bushings need to be renewed. The Bayonet people are comfortably located and they especially invite those who are interested in rapid transit to inspect their exhibit.

William Wharton, Jr., & Company, Incorporated, Philadelphia, Pa., is exhibiting, besides its standard manganese steel special work, a number of unique track devices, including tongue locks for switches, clamps for guard rails, switch stands and a new rail joint that has met with great favor abroad. An interesting booklet, giving records of service of Wharton manganese steel track work, is being distributed to callers at the booth. One of the most interesting parts of this company's exhibit is a diagram showing the comparative wear of a Bessemer rail and a cast manganese steel rail.

* * *

This year the Curtain Supply Company is showing at its booth something entirely new in the shape of a full size section of a Brill open car constructed with enclosed grooves and equipped with Ring No. 089 Curtain fixtures. This fixture embodies the same principles as the Ring No. 89 but is larger and of heavier construction and is especially designed for open car use. The Ring No. 089 fixture is always used in connection with an enclosed groove, which makes it absolutely impossible for the fixture to escape from the groove when in service.

* * *

The Public Service Commission of New York, First District, demonstrated by the extensive tests held at Schnectady and Pittsburg in 1908 that wheel guards are practical and efficient devices to protect the public from serious injury. The H. B. life guard secured the highest award in these tests both for efficiency and economy of maintenance. As a result of the tests the H. B. life guard was placed on the market in the United States last February, since when its progress has been remarkable.

It has been adopted recently by some of the largest roads in the country in less than nine months. Some of the systems using this life guard are: Third Avenue Railroad Company, New York; Metropolitan Street Railway Company, New York; Richmond Light & Power Company, New York; New York City Interborough Company; Union Railway Company, New York; Westchester Electric Railway, New York; Tarrytown (N. Y.) Electric Railway; Long Island Railroad; Montreal Street Railway Company; Savannah Electric Railway Company; Chicago City Railway Company.

* * *

Not a single fatality has been reported with the life guards in use. The following record gives a few of the recent pick-ups made on the Third Avenue Railroad: April 27, man picked up on Pearl Street uninjured. May 5, girl 15 years of age picked up on Seventy-ninth Street, unhurt. August 11, boy picked up on fender. August, 18, boy 10 years old picked up unhurt. August 19, colored woman picked up, not injured in the slightest. August 22, man and bicycle picked up, bicycle lost one pedal. The construction and operation of the life guard is simple and cannot get out of order. When once properly fitted to a car, the instantaneous operation makes it impossible for any person to pass under the wheels of the car, no matter at what speed the car may be traveling at the time of the accident. The life guard is operated by means of the person or object coming in contact with an apron or gate suspended from the car body. Immediately this gate is thrown out of the vertical position, the tray or scoop dropped to the ground, and held on the rails with a pressure of considerably over 100 lb., so that it is impossible for a person to become wedged under the carriage. To reset the life guard the motorman has merely to depress a foot pedal, which is forced through the floor of the car when the guard is tripped.

* * *

Electric railway engineers will be interested to learn that Wm. Wharton, Jr., & Company, Incorporated, will distribute a new catalogue in a few weeks. This catalogue is to be in the shape of lettered sections, each section being

confined to some specialty or subject. Thus, Section "A" will deal with records made by Wharton work; Section "B" with girder-rail work; "C" with T-rail work, and so on. These sections will be combined into loose-leaf binders, into which any additions may be inserted with little trouble. While the entire book is not yet ready, Sections "A" and "B" are, and the Wharton representative will be glad to furnish them to those interested.

* * *

Among the souvenir booklets distributed at the convention the handsome pamphlet on "Water Treatment" of the Dearborn Drug & Chemical Works deserves especial mention. In this book the history of the company is given from its small beginning, and all departments of the present extensive establishment are described and illustrated. The laboratory service for the clients of the company is carefully described, and the water treatment necessary for locomotive, stationary, marine and other boilers is discussed. Space is also devoted to the lubricating department of the company's business. The book contains a great deal of valuable information attractively presented.

* * *

At the exhibit of the Coin Counting Machine Company is shown for the first time the improved Johnson registering fare box. This box automatically counts coins of any denomination inserted in it, and at the same time sorts and deposits pennies, nickels, dimes and quarters in separate compartments of a drawer provided for the purpose. At the same time the coins are registered. If a nickel is deposited one fare is recorded; if a dime is deposited two fares are recorded, etc. If five pennies are deposited only one fare is recorded. The fare box is constructed along durable lines and occupies only a small space. W. P. Butler is in charge of the exhibit.

* * *

The Ohmer Fare Register Company of Dayton, Ohio, has an interesting display in Spaces 15-27. It is showing many types of register that record from 1 to 30 classes of fares. It also has many new devices, among them a 14-fare register, and also one for 60-fare operation. Four types of Ohmer operating registering devices, admirably arranged for pay-as-you-enter cars are exhibited. They provide for the collection of 2, 3 or 6 fares. A novelty about this exhibit is that the booth is decorated with silver and gold shields and a large flag. The seal of the State of Colorado covers one shield and the seal of the State of Ohio the other.

* * *

The H. W. Johns-Manville Company in Space 152 is showing a complete line of overhead trolley material and high-tension transmission material, including both suspension and pin type porcelain insulators for all voltages. In the State of Wisconsin alone more than 35,000 units of J.-M. suspension type insulators are being installed on the transmission lines of The Milwaukee Electric Railway & Light Company, the Southern Wisconsin Power Company and the Northern Hydro-Electric Power Company. A full line of electrical insulating material is shown, including "Vulcabeston" special moulded pieces, "Electrobestos" fireproof insulation, indurated fiber controller covers, oil switch tanks, conduit, third-rail protectors, ebony-asbestos wood in sheets and special moulded forms. "Linolite," the new system of lighting, is in operation in both tungsten filament and carbon filament lamps, demonstrating the latest types of "Linolite" reflectors for show-case and show-window lighting, picture, desk and table sets and weather-proof "Linolite" for outlining purposes. "Noark" fuses and the latest types of "Noark" car and service boxes are on display. In addition to the electrical products of this company is shown a full line of asbestos steam pipe and boiler coverings, asbestos roofings, packings and fireproof building materials of every description.

One of the interesting exhibits of the convention is that at the booth of the Felt & Tarrant Manufacturing Company, Chicago, touch operating on the Comptometer, adding and calculating machine, is demonstrated. This machine not only adds but subtracts, multiplies and divides. In fact, any business calculation may be figured on it. It holds the world's records for speed in adding 500 checks and affords an absolute method for checking the accuracy of the results. All prizes ever offered for speed and accuracy on addition and multiplication, in contests open to all machines, have been won by the Comptometer, and it is said it has now been barred from all contests as it is in a class by itself.

* * *

One of the innovations shown at the convention this year is the hot air, forced circulation, car heater which the Peter Smith Heater Company, of Detroit, Mich., is exhibiting. This heater is designed particularly for uniformly heating city cars of every type. The heater occupies a floor space only 17 in. square and is about 42 in. high. It is arranged to take cold air from the outside of the car into an air chamber and allow it to pass upward into an intake of a motor-driven blower. The blower forces the air into an inner chamber surrounding the fire-box where it is heated. The air then passes through a duct running along the floor of the car and is distributed uniformly throughout the car through openings in the duct under the seats.

* * *

Near the Champa-Street entrance to the Annex, a conspicuous feature of the car exhibit is the handsome car shown by the Cincinnati Car Company. This is one of five double-truck, semi-convertible cars built for the Ogden Rapid Transit Company, Ogden, Utah, and was intercepted on its way to its destination to be exhibited at Denver. The length of the car body over corner posts is 33 ft., and there are 6½-ft. platforms which are suspended by built-up girder trusses which form a special feature of all equipment of the Cincinnati Car Company. The car will seat 50 passengers. Its chief feature is its light weight, the car body alone weighing but 16,000 lb. This minimum weight has been obtained without in any way sacrificing the stability of the car. The company is represented by Henry C. Ebert, president of the company, who will be glad to explain to visitors the distinguishing characteristics of his exhibit.

* * *

It is seldom that a device exhibited before the convention for the first time has aroused the wide interest that has been shown in the Jones beveled rail joint exhibited by Duncan Bond, of Denver, in Spaces 621 and 623. Its features are simplicity and efficiency. The rail ends instead of being cut off vertically are cut off at a slight angle, making a bevel. The beveled ends of rails are placed firmly together in the track, and the end of one rail then supports the other. The feature of cutting the rail ends at an angle out of the vertical is patented, and a royalty charge is made for its use. The rail ends are cut to the Jones patent bevel by the rail manufacturer. Neither the rails, splice plates, bolts nor nuts are covered by patent; these may be purchased in the open market. The joints are bonded by any standard type of plastic or copper bond, no special tools or appliances are required and no allowance is necessary for expansion or contraction except where the base of the rail is exposed. This joint was thoroughly tested for five years in Denver before being offered in the market, and has now been adopted as standard by the Denver City Tramway Company. The joint is equally feasible for laying a small or large number of rails. A large number of delegates who examined the tracks of the Denver City Tramway Company found it almost impossible to detect the joints, as the equipment passes over the track without a jar. Owing to the interest shown in this joint, the Pennsylvania Steel Company and Harold P. Brown exhibited samples also.

Day's guard-rail lubricator is one of the newest inventions for lubricating the guard-rail on curves. The device saves labor, reduces the cost of the grease and also provides lubrication, thereby saving wear on both wheel and rail. It insures cleaner crossings, as the oil is evenly distributed, and it practically eliminates the disagreeable feature caused by particles of grease being carried over the rail by the wheel first coming in contact with it. The cost of operation is negligible as the work is done by the pressure of the motorman's foot without interfering with his other work. The amount of oil can be perfectly controlled, the outlet opening being regulated according to temperature. This invention is shown by William L. Day of Weldona, Colo., and is exhibited in Space 419.

* * *

Over 50,000 miles of railway equipped with the Continuous, Weber and Wolhaupter types of rail joints is the record of the Rail Joint Company. This is equal to approximately 12 per cent of the total steam and electric railway mileage in the entire United States and is enough to construct a double track road encircling the globe. The company has abundant evidence to prove that the factors of safety and economy in track maintenance have been immensely enhanced by the installation of its base-supported rail joints. The company is constantly adding improved machinery to its facilities for the manufacture of its base-supported rail joints. In its exhibit at Spaces 156-158 various types of standard T and girder rail sections are displayed, as well as different types of insulated joints. The interests of the company at the convention are looked after by F. C. Webb, J. A. Greer, W. T. McCaskey, W. E. Clark, E. L. Van Dressar and P. D. Watson.

* * *

The exhibit of Cortlandt F. Ames of Chicago in Space 713, contains many novelties of interest. One of these is an automatic lock nut, which will not rust on the bolt, but can be taken off at any time. It is practically indestructible as well as fool-proof and is adapted for motor, truck and track work. A compound manufactured by the Ohio Filler & Shield Company, for lubricating gears forming a shield or coating over the teeth of the gear and pinion, eliminating noise and the metallic contact, saving wear on the teeth and lengthening the life of the gear is also shown. Similarly, rope shield, axle shield, roof shield and metal shield compounds protect the apparatus for which they are designed. The Hercules pumping post, one of the Ames specialties, is made entirely of steel and malleable iron. It is said that it will stand more abuse than anything made for this purpose. Trolley poles, steel poles for all purposes, babbitt metals and bronze bearings are shown by Mr. Ames.

* * *

One of the exhibits which is attracting a great deal of interest is the 70-ft. McKeen motor car designed and built by the McKeen Motor Car Company of Omaha, Neb. W. R. McKeen, Jr., formerly superintendent of motive power and machinery of the Union Pacific, is president and general manager of the McKeen Motor Car Company and has been one of the first mechanical engineers to realize the great possibilities of the gasoline engine. The car consists of a passenger compartment seating 54, a smoking compartment seating 10, a 9½-ft. bagage room, 7-ft., railroad postoffice and the engine room.

The car is propelled by a 200-hp 6-cylinder internal combustion engine built by the McKeen Motor Car Company, which is mounted on the front truck independent of the car body, thereby relieving the car of all vibration. The power from the engine is transmitted direct to the main axle by means of a Morse silent chain transmitting power at 96 per cent. efficiency.

The car is of all-steel construction and is handsomely finished in Cuban mahogany and lighted by the Commercial acetylene system. One of the unique features is the ventilating system, fresh air being delivered to the floor of the car and the foul air exhausted to the roof. Other novel features are the round windows, giving a wind, rain and dust-tight window, and the center entrance which does away with the step box. In the winter the steps are free from ice and snow. The round windows and center entrance design also permit of a much stronger frame construction than would be possible otherwise, the sides of the car forming a combination truss and plate girder.

The car is 70 ft. long over end sills, 9 ft. 8 in. wide inside and 7 ft. 5 5/8 in. high from floor to ceiling. It weighs 68,000 lb. in working order.

The McKeen Motor Car Company now has 53 cars of this type in service or on order by 25 railroad companies.

* * *

The bonding tools exhibited by the American Steel & Wire Company always attract the attention of practical railroad men. The single-end four-spindle drills, both hand and motor driven, are unique and simple in design, remarkably efficient and are admirably adapted for quick and accurate drilling of rails for bonds. A very interesting rail bond testing equipment made by this company is shown for the first time. The measurements of rail-joint resistances are read off directly from self-winding tape lines in feet of rail. The instrument differs in design from anything heretofore shown and is well worth seeing. Bonds of various types are shown, among them those adopted in the electrification of the New York, New Haven & Hartford Railroad, New York Central Railroad, Pennsylvania tunnels in New York City and the feeder rail bonds for the Detroit River Tunnels. Paper and rubber insulated lead-encased cables are shown, also springs, wire rope and American right-of-way fence, and other materials of interest to railway men.

* * *

In Space 413 in the Auditorium Building will be found the attractive exhibit of Invincible renovators, manufactured by the Electric Renovator Manufacturing Company of Pittsburg. This exhibit is in charge of C. P. Fenner, sales manager of the company, and Mr. McCauley, the local representative. The exhibit includes the Commercial and Domestic models of the Invincible machines, which are suitable for the cleaning of the interior of cars, including upholstery, curtains, etc., and also for the blowing out of generators, car motors, and other inaccessible parts of the equipment. These machines are also very largely used by hotels, theaters, churches, lodge-rooms, apartment houses, etc. A new production is the Invincible Junior machine, which is light and easily portable, but at the same time has a degree of efficiency approximating the larger models. This small machine uses only a ¼-hp motor, and weighs only about 65 lb.

* * *

The Electric Service Supplies Company, Philadelphia, Pa., has a large booth in the Auditorium opposite the convention hall entrance where it is exhibiting a number of new specialties and a full line of standard apparatus. Among the new devices shown are the improved St. Louis trolley wire pick-up which is adjustable to take any size of wire; a double air valve for operating a Keystone pneumatic sander and Keystone gong ringer; an improved design of Automotoneer and controller handle with adjustable lock on the controller shaft and a new type of line lightning arrester. Lyon reinforced steel gear cases, Keystone trolley material for ordinary and catenary construction, protected rail bonds, bell cord and other standard apparatus are included in the exhibit. In the center of the booth is a full-sized operative section of a "Pay-Within" car. This feature of the exhibit has attracted attention from nearly every railway man present at the convention. A number of large orders for cars of this type are in prospect as a result of the convincing demonstrations of this sample equipment.

EARLY HISTORY OF CARBON BRUSHES IN THE UNITED STATES

The following interesting review of the history of carbon brush manufacture in the United States has been prepared from notes furnished by J. S. Speer, president of the Speer Carbon Company, St. Marys, Pa.:

Carbon brushes were first manufactured in the United States in 1887 by James Partridge and Robert Loughlin. The factory was located in Mahoning, Pa. After considerable experimenting these two pioneers in the field succeeded in producing motor brushes which operated very satisfactorily on old Sprague motors which were among the first commercial dynamo-electric machines on the market. In 1890 Mr. Partridge and Mr. Speer organized a company and built a factory for the manufacture of carbon brushes at Sandusky, Ohio, where the famous Partridge self-lubricating carbon brush was made for many years. In 1899 the National Carbon Company bought the Partridge Carbon Company's factory and Mr. Speer went to St. Marys, Pa., and organized what is now the Speer Carbon Company. The carbon brushes made in 1893 to 1895 gave a mileage in service of 5,000 miles, which was considered phenomenal at the time. The brushes made by the Speer Carbon Company at the present time give records of from 50,000 to 60,000 miles.

EXHIBIT OF THE LORAIN STEEL COMPANY

The Lorain Steel Company is showing an approved form of tongue switch. The main structure is of open hearth steel. The wearing plate, which extends beyond the tongue both at the point and heel and the tongue proper are made of the well-known "Guarantee" brand of superior, high quality managanese steel. The inherent feature of this switch is in the broad bearing given to the tongue at the heel. The diameter of the tongue heel is 9½ in., assuring a solid bearing equal to 60 sq. ins., or five times the support accorded in ordinary street railway practice. Almost this entire area is found in the base of the wearing plate, which is ground to a perfect bearing for the full length of the tongue, only a small portion in the center being cored to admit the lug which is cast fast to the base of the tongue. This lug is not depended upon to center the heel of the tongue, this office being performed by the sides of the cylinder which are ground to a perfectly true circle to receive the heel of the tongue in an absolutely perfect mechanical fit. The lug is provided as a means of retaining the tongue on its perfect bearing under conditions of snow, ice or mud. By applying pressure through the small lever shown, the tongue is held securely on its bed with a pressure of over 2 tons, and yet may be thrown with the ordinary switch iron, and if required to be removed the operation is one only of a few minutes. Provision is made to attach a box to either side of the switch, containing spring or locking mechanism, and all tongues are provided with a small lug on the lower side, near the point, for attaching to spring locking device or electrical equipment. The mechanical features are such as will appeal to all users of special track work material, viz., simplicity and fewest possible parts. The switch is furnished in 7 and 9-in. girder guard rail sections, or with ends to match 6, 7 and 8-in. high T-rail sections. The main structure is not less than 7 in. in depth even when the ends are made to match 6-in. high T-rail.

In steam railroad crossing construction is shown a solid manganese steel crossing. This type is fast replacing the "built-up" type made of rolled rails, fillers, brackets and bolts, as these are almost entirely eliminated by casting the structure in one solid piece. The use of bolts, etc., is absolutely dispensed with excepting at the outside joints connecting with the main tracks.

Railroad frogs for main line use with manganese steel centers, frogs for sidings or extra heavy yard service with wing rails only of manganese steel, and various railway track specialties where the use of manganese steel has become an important feature in railway service are exhibited in various forms.

Specimens of electric welding of tracks are also shown in all stages of this interesting process. The Lorain Steel Company is represented by a number of officers of the company and the exhibit is in charge of A. S. Littlefield and S. P. McGough of Chicago.

THE RECOMMENDED RAIL SECTIONS

C. W. Gennett, Jr., calls attention to a statement in section 1 of the concluding recommendations of the committee on way matters, which presented a report on Oct. 5, as published in abstract in the Electric Railway Journal for Oct. 6, 1909, page 698. The report read that the committee remommended the use of "T-rails weighing not less than 80 lb. per yard, adopted as 'recommended practice' by the American Railway Engineering & Maintenance of Way Association, April 22, 1908." Mr. Gennett, who is engineer in charge of rails and rail fastenings for R. W. Hunt & Company, Chicago, and has closely followed the development of rail rolling, has noted that the section which should have been mentioned in the report was recommended originally by the American Railway Association and not by the American Railway Engineering & Maintenance of Way Association. Anyone interested in the details of this rail may obtain from Mr. Gennett, who is stopping at the Shirley, a pamphlet which presents complete drawings and dimensions of the 80-lb. rail section as adopted by the American Railway Association.

The Atlas Railway Supply Company of Chicago is showing a full line of Atlas rail joints, tie plates and rail braces.

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H. B. Logan, president of Dossert & Company of New York, reports the receipt of an order from the Milwaukee Railway & Light Company for 1000 new type cable tap connectors to take a 400,000-cm copper branch cable off of 800,000-cm aluminum feeder cables. The device is a variation of the standard Dossert cable tap connector, giving aluminum contact where the tap is taken off the aluminum feeder cable and copper contact where the copper branch cable enters the connector. H. B. Logan is showing the new connector at the convention.

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Representatives of the Kerite Insulated Wire & Cable Company, while being shown a view of the city from the roof of the Boston Building by E. E. McClintock, superintendent of the Mountain Telegraph Company, observed a coil of about 50 ft. of telegraph cable lying on the roof. Upon investigation it was found to be Kerite. When asked about it Mr. McClintock stated that the coil had been lying on the roof for a year and was a section of a piece of cable which is in use and had been purchased by the telegraph company some eight or nine years ago. The cable was tied up with a piece of Kerite wire and both the tie wires and the cable were in good condition. Mr. McClintock has presented Mr. Miller of the Kerite Company with a piece of the section of the cable and of the tie wire, with a letter stating the circumstances.

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The Utah Light & Railway Company, Salt Lake City, Utah, has a delegation of seven of its representatives in attendance at the convention, as follows: Joseph Wells, general manager; R. E. Hunt, assistant general manager; Will Brown, auditor; L. L. Dagron, engineer; E. E. Franklin, master mechanic; A. E. Baum, superintendent of construction; W. Scott, superintendent of overhead construction.