Electric Railway Journal

A CONSOLIDATION OF

Street Railway Journal and Electric Railway Review

VOL. XXXVI. NEW YORK, SATURDAY, JULY 9, 1910 No. 2

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

239 WEST THIRTY-NINTH STREET, NEW YORK

JAMES H. MCGRAW, President.

HUGH M. WILSON, 1st Vice-President. A. E. CLIFFORD, 2d Vice-President.

CURTIS E. WHITTLESEY, Secretary and Treasurer.

TELEPHONE CALL: 4700 BRYANT. CABLE ADDRESS: STRYJOURN, NEW YORK.

HENRY W. BLAKE, Editor.

L. E. GOULD, Western Editor.

Associate Editors:

RODNEY HITT, FREDERIC NICHOLAS, WALTER JACKSON.

News Editors:

G. J. MACMURRAY, FRANK J. ARMEIT.

CHICAGO OFFICE.....1570 Old Colony Building

CLEVELAND OFFICE.....1015 Schofield Building

PHILADELPHIA OFFICE.....Real Estate Trust Building

EUROPEAN OFFICE....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION:

For 52 weekly issues, and daily convention issues published from time to time in New York City or elsewhere: United States, Cuba and Mexico, $3.00 per year; Canada, $4.50 per year; all other countries, $6.00 per year. Single copies, 10 cents. Foreign subscriptions may be sent to our European office.

Requests for changes of address should be made one week in advance, giving *old* as well as new address. Date on wrapper indicates the month at the end of which subscription expires.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to Tuesday noon of the week of issue.

Entered as second-class matter at the post office at New York, N. Y.

Of this issue of the ELECTRIC RAILWAY JOURNAL, 8500 *copies are printed.*

NEW YORK, SATURDAY, JULY 9, 1910.

CONTENTS.

Summer Uniforms

The advent of hot weather again brings to the front the question of a comfortable costume for the platform men. The sentiment that the dignity of a railway company requires each of its conductors and motormen to wear his usual tight-fitting coat, regardless of the temperature in summer, has largely disappeared in those cities which are visited by periods of almost tropical heat during July and August. Even in New York a variety of costumes can be observed on the front and rear platforms of cars just as it can in the office buildings and on the streets of the city. One metropolitan company has authorized its men to discard coats and wear a shirtwaist, the trousers being supported by a belt. A second provides its motormen with a blouse, which renders the use of a coat unnecessary. A third provides khaki uniforms which are lighter and cooler than the usual blue cloth suits, while another permits the men simply to discard the standard coat during very hot weather. The men of still another road, with the permission of the management, have substituted straw hats for the standard caps. The variety in practice thus exemplified in one city suggests the desirability of a further study of this question, preferably by a committee of the association, which would have an opportunity of learning the practice and obtaining the opinion of companies in different parts of the country. The problem is more serious with the conductor than with the motorman because the former requires pockets for his transfers, punch, and so forth. Khaki has many qualities to recommend it, as its efficiency as a non-heat absorbent has been shown by its extended use in the United States Army, both for home and tropical service, and as it has become associated with military affairs, it gives the car men a desirable soldierly appearance. It is not necessarily, however, the most desirable costume to adopt, and the experience of other companies on the general subject of summer uniforms should prove very instructive.

City Planning and Transportation Systems

When Napoleon III improved Paris by cutting avenues through city blocks, widened narrow streets, spanned the Seine with new bridges and laid out squares to beautify the city, he was but setting an example which has been followed in other cities, although perhaps not on so extensive a scale. Abroad, the question of city planning has become a definite science, in which the transportation needs of the territory to be served are very carefully considered. In this country the subject is left largely to the whims of real estate promoters and speculators and the transportation companies are often obliged to install their tracks as best they may after the rest of the work is completed, or at least decided upon. Pittsburgh, however, hopes to prove an exception to the usual careless method of city development in this country and the report of the Pitts-

burgh Civic Commission on city planning, just published, indicates at least a serious attempt to make the city more convenient, more economical and more healthful, as well as to improve it esthetically. The methods of accomplishing these results are outlined in a report adopted by the commission and prepared in collaboration by Bion J. Arnold, of Chicago; John R. Freeman, of Providence, and Frederick Law Olmsted, of Boston, whose recommendations are divided into nine topics, among which the future functions of the electric railway system form a conspicuous part. The experts did not attempt to outline a complete course of precedure, as that would have required a more thorough study than they were able then to give it, but the further data required for this purpose are outlined in the report. The plan of the commission and of its experts is a commendable one and if the step is taken up with the earnest spirit for which Pittsburgh is famous and is carried out with the enterprise which has distinguished the commercial undertakings in that city, it may be that Pittsburgh will eventually be known as the City Beautiful of the American continent, as well as what is equally or more important, the City Useful, Economical, Convenient and Healthful.

Policing the Power Consumption on the Car

The vast differences in the skill and care of motormen running over the same routes, as regards the economical use of power, are clearly brought out in Mr. Putnam's A. I. E. E. paper on the Manhattan Railway coasting clock tests. This paper and the ensuing discussion are abstracted elsewhere in this number. Taking the Manhattan Elevated Railway system as a whole, it was found that the average car acceleration of different motormen varied from 0.9 m.p.h.p.s. to 1.47 m.p.h.p.s., and the corresponding times spent in coasting varied from no per cent to 40.5 per cent of the time spent in making the trip. In terms of energy, this difference in practice corresponded to a saving of the most economical motormen over the most wasteful motorman of 36 per cent. Of course, these figures represented extremes, but even the average result on the Second Avenue line showed that a power economy of 25 per cent was attainable. According to a statement made in the discussion by Mr. Stillwell, who checked the original tests for the Interborough Rapid Transit Company, the last percentage represents a money saving of $1,000 a day. Perhaps the most interesting feature of the tests is that these astonishing results were obtained with such a comparatively simple device as the coasting clock described. Formerly it was believed that some power measuring device like an ampere-meter or watt-meter was needed for this purpose, but experience proved that they were not only unnecessary but less desirable than the simple time registering device. In a way, the New York contrivance is the converse of that used on the Berlin and other German street railway systems. In the latter, a shunt circuit operates an ordinary clock only when power is passing through the controller, whereas in New York the clock runs only when the car is coasting. In Berlin, the use of these clocks enabled the company to increase the schedule speed 10 per cent besides securing an appreciable reduction in power consumption. Moreover, comparisons of the records of these current-hour instruments with watt-hour meters used on the same service showed remarkably like results. Apparently, the policing power of instruments of this character is sufficient to attain the desired comparisons of running skill and of saving in power.

PEAK LOAD CONGESTION AND ITS REMEDY

The first step in securing a reform in public matters is to call attention to the abuse; the second is to find the remedy, and the third is to keep everlastingly talking about both the trouble and the remedy until the latter is adopted. For a long time the only remedy for the street railway congestion problem, in the minds of the public, was the operation of more cars, but the part which the public itself can do in relieving congestion is becoming more generally appreciated. A continuous line of cars would be insufficient in number to give every one a seat in most of our manufacturing towns if all the employees in the various factories wish transportation at the same time. The suggestion was made in this connection a few years ago by Mr. Fassett, general manager of the United Traction Company of Albany, that the manufacturers in Troy should so arrange the working hours of their employees that the latter would not all have to go to work and would not stop working at exactly the same time. Mr. Fassett's efforts to induce the Troy manufacturers to adopt this plan did not prove successful, as both employers and employees had become so used to certain working hours that it was not considered possible to alter them, even by a few minutes. But it is interesting to note that this remedy for traffic congestion was strongly indorsed in a speech made last week at the banquet of the New York State Street Railway Association by John N. Carlisle, Public Service Commissioner of the Second District of New York.

The Pennsylvania State Railroad Association, in its opinion just rendered upon the condition and situation in Pittsburgh, has also called attention to the necessity of some action on the part of the public to reduce traffic congestion. This opinion was based on the report recently submitted to the commission by Emil Swensson. According to the report, during the crowded period in Pittsburgh, every one insists upon taking the first car. Continuing, the Commission says: "For those whose day's work has been hard and long, and whose hours at home are necessarily limited, there is some excuse for such insistent haste; but those who can control their own time and movements should ordinarily set a better example by the exercise of a little patience, and thus contribute to the comfort of themselves and others. A complaint of overcrowding comes with bad grace from such persons, for by their action in boarding a crowded car they but intensify and augment the trouble about which they complain."

The commission likens the congestion problem in Pittsburgh, and the example applies equally in other cities, to a three-legged stool, and says that unless the three necessary factors in the situation, the company, the public and the municipality, do their duty, the whole attempt at reform will fall to the ground. The part of the company is to furnish the cars when needed, but it alone cannot solve the problem. The duty of the public has already been described. The duty of the municipality is partly to grant authority to the railway companies to make such changes in routes as may be necessary to simplify and expedite the operation of cars, partly to facilitate car operation through the widening of streets and improvement of the street surface and partly through the police department to insure a regulation of street traffic, so that car operation will not be impeded. The trouble in the past has been that people unthinkingly have assumed the stool had only one leg

and that the railway companies should supply all the cars necessary to give every one a seat at all times of the day, and should then be able to carry passengers quickly to their destinations.

ACCIDENT INSTRUCTION FOR SCHOOL CHILDREN

We have already referred to the notable paper on accident prevention presented at the March 24 meeting of the Central Electric Railway Association by E. F. Schneider, general manager of the Cleveland, Southwestern & Columbus Railway. As our readers will recall, Mr. Schneider told how the injuries and claims account on his lines had been cut down from an average for 10 years of 6.35 per cent of the gross receipts to 1.25 per cent, partly through talks to the trainmen, but principally through a campaign of education among the school children on methods of avoiding accidents. By inaugurating this course Mr. Schneider attacked the accident problem at its root. Warnings to adults, whether patrons or employees, are well enough in their way, but at best it is not an easy matter for grown-up folk to change set habits readily. The woman who gets off a car backward and the man who makes a flying leap for the running board usually have done so too long to pay much heed to the counsel of anybody. Instruction of this kind most properly should begin with the child before it has formed the careless habits of its elders.

The most obvious method of conveying this instruction is through the school teachers. Mr. Schneider tried this method first, but soon learned the truth of the adage "If you would have a thing well done, do it yourself." It must not be inferred, however, that the teachers really were indifferent or unwilling to help. The average pedagogue has too many direct duties to leave much time or enthusiasm for matters which are not in the curriculum drawn up by his or her superiors. The school-room talks by Mr. Schneider or his aides usually varied in length from 10 to 20 minutes during which the children were told many important points about the need for care on the streets and on the cars. The effect of these talks may be judged from the fact that during last year not a single accident occurred to a child on a total of 217 miles of city and interurban track. In all, some 360 addresses were made to 42,000 pupils from kindergarten to high school age. It is needless to add that the parents of these children cordially appreciated this evidence of "soul" on the part of this corporation.

Our object in directing attention to this particular case is to point out that campaigns of this character can be followed in other localities. Thus the Portland (Ore.) Railway, Light & Power Company has been giving lectures to public school children and stimulating their interest by prizes for essays on accident topics. Last month, the Cincinnati Traction Company cooperated with the local boards of public service and education in the preparation and distribution of an accident instruction pamphlet for school use. The United Railways & Electric Company of Baltimore has also gotten out for the same purpose a poster which illustrates most effectively the right and wrong way of getting off a car and is suitable for permanent display on the school-room walls. The publication of such literature is greatly to be commended and should assist in reducing accidents. It is especially valuable when combined with a lecture system, for it helps to strengthen and fix in the minds of the children the impression made upon them by the oral instructions.

ENGINE ROOM ILLUMINATION

Adequate lighting plays an important part in the operation and maintenance of engines and turbines. The increasing size of prime movers renders it more and more necessary to avoid mistakes in handling generating equipment and to forestall impending trouble by close and frequent inspection. The larger the engine room, the more difficult it is to secure a good distribution of light at moderate cost. Much can be accomplished by breaking away from the old practice of attempting to light the engines and turbines by a large number of carbon filament lamps placed high up on the roof trusses, with the usual accompaniment of dull-finished walls and enamelled tile wainscoting.

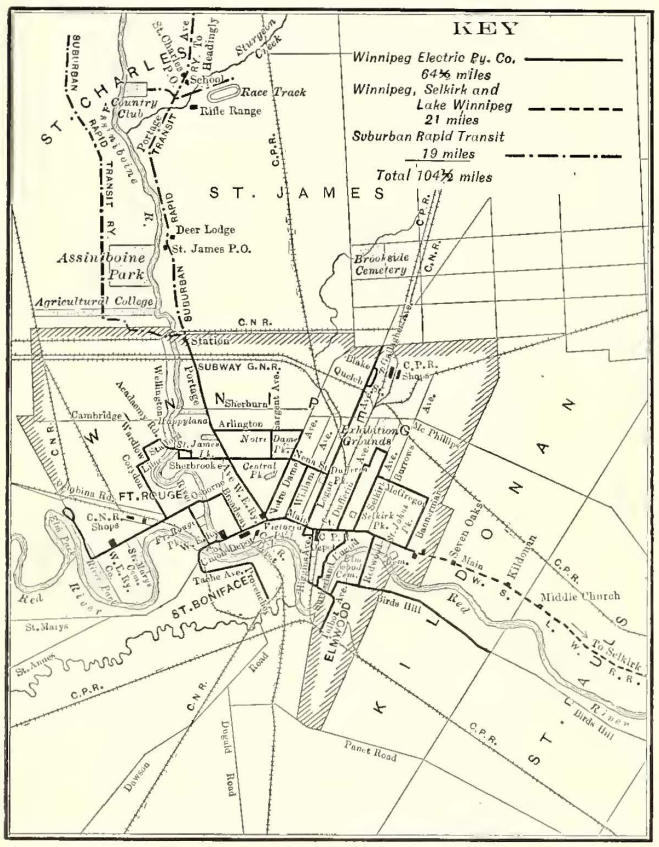
Two plants, recently visited, illustrate the point that the amount of electrical energy expended in illumination of the engine room is not always a measure of the effectiveness of the illumination. In the first station the engine room was 90 ft. long and 50 ft. in width, the bottom chords of the roof trusses being about 35 ft. above the floor. The lighting was accomplished by about 100 16-cp carbon incandescent lamps, located 24 in. apart on the underside of the trusses, a few side lamps on the walls, and twelve 16-cp incandescent lamps on each of the three engine and generator units. The energy expenditure was about 1.6 watts per sq. ft. of floor area. The resulting illumination, however, was poor on account of the absence of reflectors above the lamps on the truss chords, the constant accumulation of dust and dirt on the relatively large number of small lighting units employed, and the comparatively wide spacing between trusses in proportion to the size of the room. The machinery was painted black, and the walls were not tiled.

The second station had a turbine room 112 ft. long by 43 ft. wide, the height from the floor to the roof girders being 53 ft. Here 56 tungsten lamps were installed, with concentrating reflectors on the underside of the roof trusses. The lamps were suspended in rows of eight, spaced 60 in. apart on the girders, which in turn were spaced 14 ft. apart. The side walls were painted a dull red color, and the expenditure of energy for the room was only 1.17 watts per sq. ft. of floor area. The diffusion was excellent, and shadows were practically eliminated. The smaller number of lamps installed facilitated their being kept clean and the reflectors utilized a large proportion of the light rays, which in the first plant was either absorbed by the ceiling, or scattered at all angles, without definite direction toward the machinery.

The use of high efficiency lamps with reflectors in general gives much better results for the same expenditure of energy than using carbon lamps with an efficiency of but 3.5 watts per cp. With walls completely finished with enameled tile the results can be still further improved. Broadly speaking, it is better to spend money for first-class tiling than to attempt to secure the same intensity of illumination by increasing the number of lamps used in connection with dull finished walls. It also pays to subdivide the lighting circuits where a considerable number of lamps is used, the usual plan being to arrange each alternate line of lamps on the trusses on the same circuit. Economy of operation can be secured in this way, since there are many times each year when suitable illumination can be obtained by burning only half the engine room lamps. Whatever the system, the results are dependent upon clean globes, perhaps, more than upon any other single factor.

CONSTRUCTION AND OPERATING FEATURES OF THE WINNIPEG ELECTRIC RAILWAY

The Winnipeg Electric Railway was one of the first roads in Canada to be operated by electricity. Service was started in June, 1892, after the horse-railway property of the Winnipeg Street Railway, built some years before, had been re-equipped. The growth of the city and community has been steadily accelerating until now the population increases at the rate of



Winnipeg System—Map of Local and Suburban Lines

10,000 new inhabitants per annum. In 1908 at the taking of the last official census Winnipeg had a population of 123,250; less than 40 years before it was a trading post of 200 people. The railway company's property likewise has grown from a short horse-car line with two cars in 1888 to a system now including 104.5 miles of track, a 30,000-hp hydroelectric station and 65-mile transmission line, and the residence and commercial gas, electric lighting and power services for the entire community. In 1900 the railway carried 3,000,000 passengers; last year the total was approximately 26,383,000.

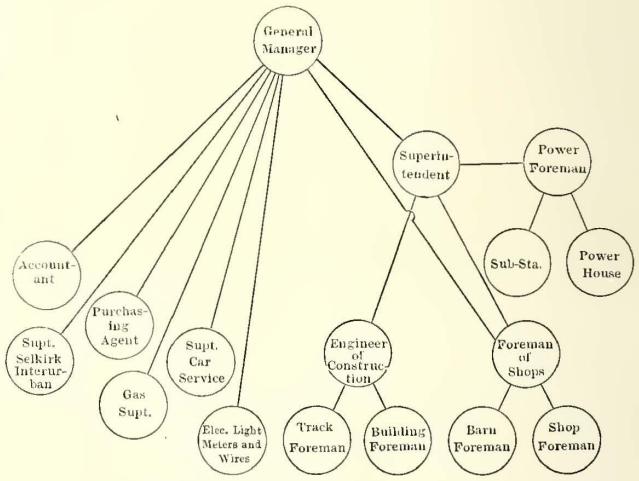
The following statistics showing the importance of Winnipeg may be of interest:

Area of city, acres	13,990
Miles of paved and graded streets	300
Park acreage	316
Building permits for January-April, 1910	1,006
Total assessment city property, 1908	$116,101,390
Railway lines serving city	22
Grain handled yearly, bushels	200,000,000
Banks and branches	59
Bank clearings, 1908	$614,111,801
Bank clearings, January, February, March, 1910	$182,448,550

While the city grows at a remarkable rate, nevertheless the stores and residence buildings are handsome and substantial structures. The property of the Winnipeg Electric Railway Company, likewise, is of interest because during its rapid expansion the management has designed and built the roadway and other structures with an eye for permanency and low cost of operation and maintenance.

The statistical statement below shows the growth of the property in a financial and traffic way during the last five years.

A single organization handles the operation of the railway, electric light and power and gas properties. The officers of the Winnipeg Electric Railway Company are: William Mackenzie, president; William Whyte, vice-president; F. Morton Morse, secretary-treasurer; manager of all properties, Wilford Phillips, who also is chief engineer. The manager is assisted in the engineering work by Wilson Phillips, who has the title of superintendent. The inter-relations of the operating organization are shown by the accompanying chart.



Winnipeg System—Organization Chart

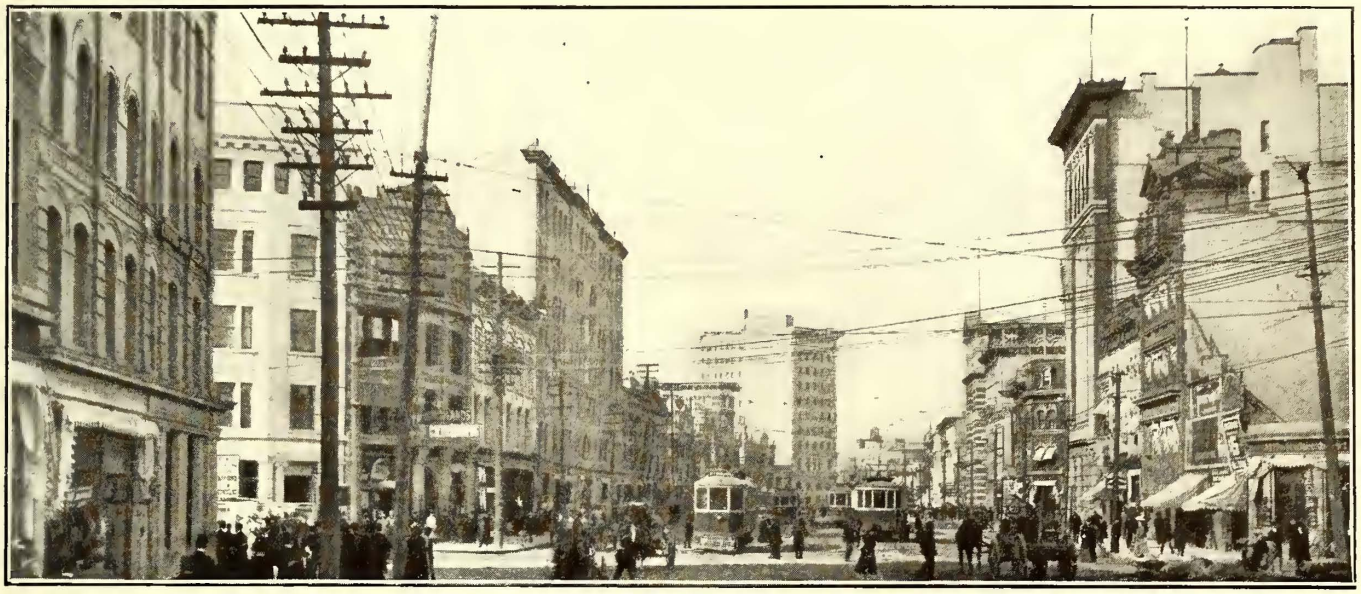
TRACK CONSTRUCTION

The Winnipeg Electric Railway Company operates 104.5 miles of track owned by the following companies: Winnipeg Electric Railway Company, 64.5 miles; Winnipeg, Selkirk & Lake Winnipeg Railway, 21 miles; Suburban Rapid Transit Company, 19 miles. With the exception of the suburban and interurban lines, practically all of the mileage is double-tracked. The construction of the Selkirk interurban line will be described in a later article.

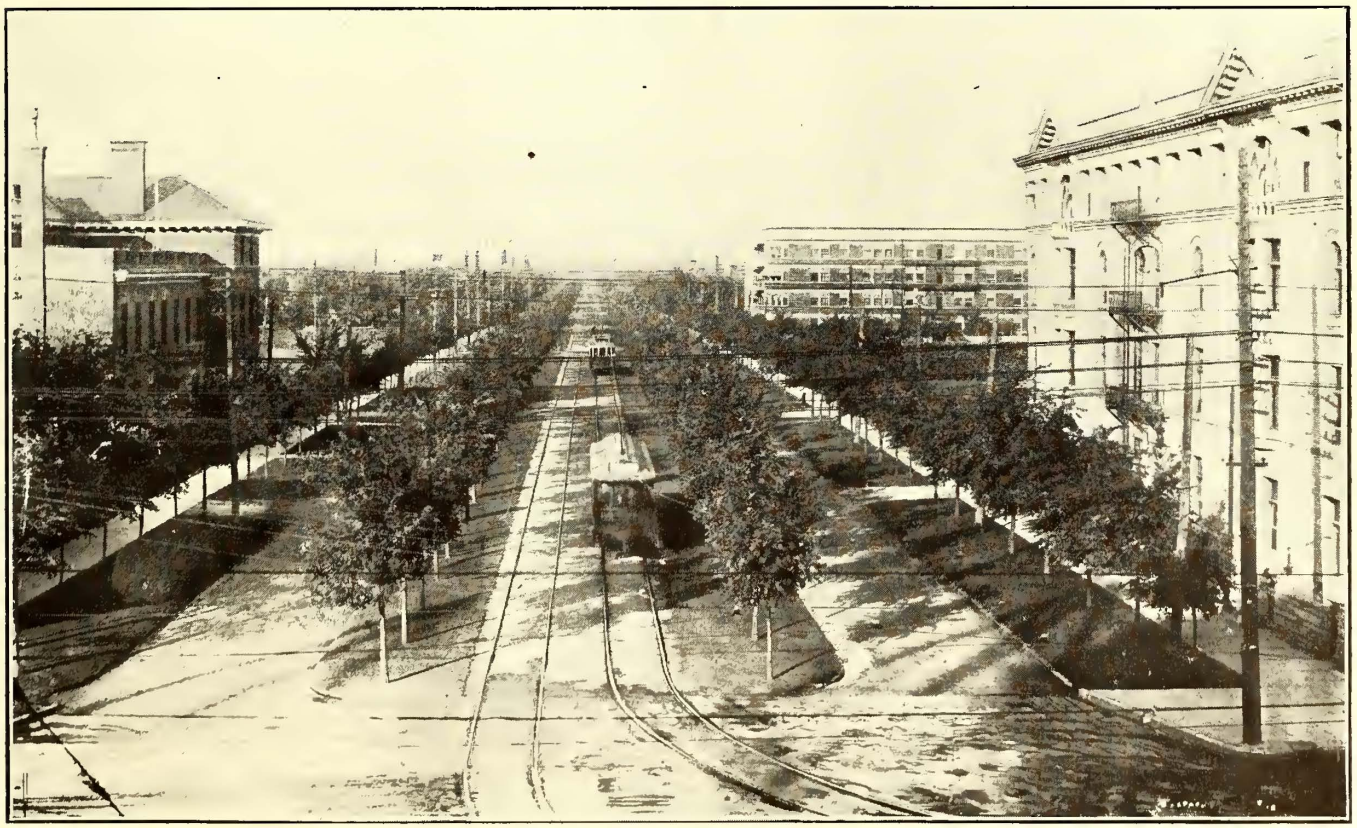
Winnipeg is located on a broad, level plain at the junction of the Red and Assiniboine rivers. The city is laid out with wide streets. On boulevards the double tracks are built along a parkway in the center. The generous width of the streets permits intersecting curves of long radius; also, this road is perhaps unique in that all its track is on level grades, except at subways under steam railroads. These features have assisted in the building up of an excellent track system. Another feature, however, which has called for particularly careful work and heavy construction in building track is that of soft soil. The prairie on which Winnipeg is located is covered with a deep layer of loam and has practically little fall for natural drainage. The city has 300 miles of paved and graded streets,

	1909.	1908.	1907.	1906.	1905.
Gross receipts	$2,623,731.41	$2,206,094.88	$1,722,406.69	$1,416,305.04	$1,119,768.85
Increase 1909 over 1908—18.93 per cent	$417,636.53				
Operating expenses	$1,320,665.09	$1,088,872.50	$775,731.02	$701,963.72	$575,747.29
Increase 1909 over 1908—21.29 per cent	$231,792.59				
Operating expenses, per cent of earnings	50.34	49.35	45.05	49.56	51.42
Net earnings	$1,303,066.32	$1,117,222.38	$946,675.67	$714,341.32	$544,021.56
Increase 1909 over 1908—16.63 per cent	$185,843.94				
Net income per cent of capital	14.39	13.14	12.01	11.17	9.86
1909, $6,000,000.					
1908, $5,669,541 average.					
1907, $4,664,200 average.					
1906, $4,144,480 average.					
1905, $4,000,000.					
Passengers carried	26,382,773	22,019,507	20,846,317	17,229,554	13,081,249
Increase 1909 over 1908	4,363,266				
Transfers	8,925,849	7,777,315	5,954,067	3,109 094	1,682,685
Railway earnings per capita	10.03	9.80	9.84	8.30	6.80

the major portion of the surfacing having been done with asphalt. On unpaved streets, however, the railway company has been obliged to use special care in constructing its tracks so that the substructure will be well drained. All double-track lines, with the exception of two, are laid with 12-ft. track centers. On Main and Portage streets, the principal business thoroughfares, the tracks are laid with a center distance of 25 ft. 3 in. These streets have the remarkable width of 132 ft.



Winnipeg System—A Scene in the Retail Section of Winnipeg



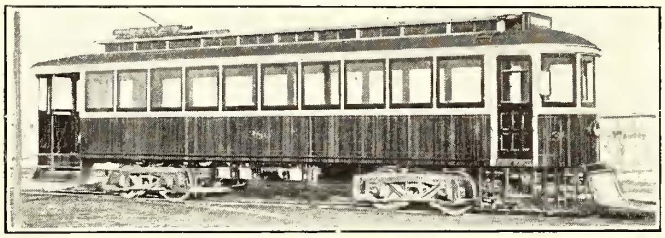
Winnipeg System—View of Double-Track Parked Boulevard Construction

An illustration on the next page shows the design of track structure which has been found satisfactory. The rail adopted as standard is a 7-in. 80-lb. high T-section with a 2½-in. head. These are laid on large tamarack ties, which cost from 50 cents to 60 cents each. Tamarack ties have been found to be good after having been underground for seven years. The ties are supported and enclosed in a layer of concrete, which extends 6 in. below the bottom and 4 in. above the tops of the ties. Beneath this concrete foundation is a 3-in. layer of broken stone extending the full width of the trench and draining into a 4-in. tile line, also laid in broken stone, and extending under the entire city trackage. The tile subdrains discharge into the city sewerage system. Between the inside ends of the ties a foundation for the pavement of the devil strip is made by placing a 10-in. layer of concrete on 3 in. of broken stone.

The major part of the pavement is asphalt surface and binder 3 in. thick. The city has its own asphalt plant and is employed by the company to put down the street surface between the rails and in the devil strip. The company has a granite quarry near its hydroelectric station from which stone is obtained for stretcher and filler blocks. Kettle River sandstone also is used, and the railway company now has on hand

an order for vitrified clay blocks, 6 in. x 6 in. x 8 in. in size, which will be laid as an experiment. The stone setts are 6 in. deep and grooved to fit under the heads of the rails so that they come in contact with both sides of the web. In some of the earlier track construction stretchers of wood, dressed to fit the contour of the rails and provide flangeways, were used in asphalt paved streets. Criticisms of this construction are that it admits water to the substructure and does not wear as long as the pavement.

The special track work used is built partly of 90-lb. and



Winnipeg System—City Car

partly of 80-lb. section rails. Some all-manganese intersections, built by the Montreal Steel Company, are used, but the larger part of the special track work has been furnished by the Lorain Steel Company and the Pennsylvania Steel Company, embracing the designs with manganese wearing pieces known as "Guaranteed" and "Manard." Continuous six-hole plates are used at joints. Several types of rail bonding are in use. The first rails laid were bonded with round wire and bonding caps. On later construction American Steel & Wire flexible bonds with pins and Ohio Brass Company all-wire bonds with compressed terminals were employed. At the present time all new track is being bonded with one No. 0000 flexible copper bond electrically welded to the rail by a bonding car supplied by the Electric Railway Improvement Company. The track near substations is double-bonded, and all special track work is passed with 500,000-circ. mil cable electrically welded to the rails. Cross-bonds also are welded to the rails at intervals of 1000 ft.

EXTENSIONS

The Suburban Rapid Transit line extends 12 miles directly west of Winnipeg, serving the rifle range, race track, country club and the town of Headingly. Six miles of this suburban

Winnipeg System—Car Storage at Repair Shops

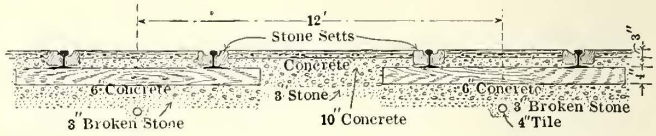
line between the race course and Winnipeg are double-tracked. An extension of 10 miles west of Headingly is under consideration. Another extension now being planned is that to the new shops of the Grand Trunk Pacific Railroad, 6 miles east of Winnipeg. The track construction department has as a storage yard a part of the 35-acre tract of land on which the car construction shops are located. The material yard here is laid out according to a definite plan and is provided with a large derrick for transferring heavy freight from steam to electric cars.

OVERHEAD CONSTRUCTION

For the most part the trolley wires of the Winnipeg Electric Railway are carried by span wires. The poles used are cedar and tamarack from British Columbia. The company now is planning to use steel center poles on some of the wider streets. No. 00 wire is standard, and this is supported by uninsulated hangers protected by strain insulators in the steel-strand span wires.

TRANSPORTATION FEATURES

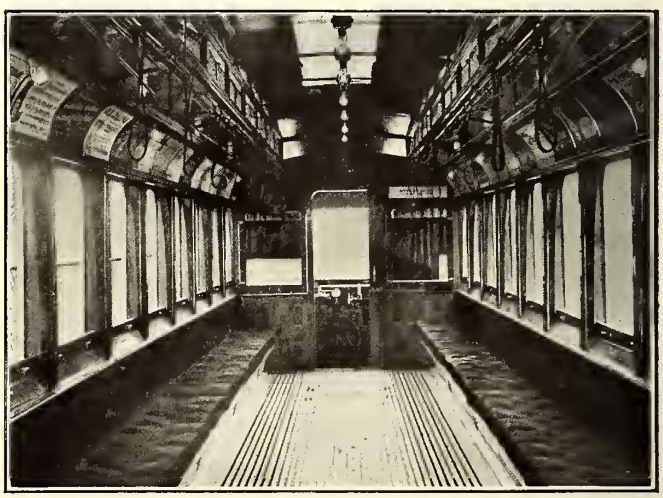
The Winnipeg Electric Railway regularly operates 106 cars in its week-day schedule, except at the morning, noon and evening rush hours, when 150 cars are required. During the summer months open cars and trailers are used in addition to large double-truck closed cars, so that the total number of



Winnipeg System—Track Construction

units in service reaches nearly 200. No service is given between 2 a. m. and 6 a. m. Practically all of the lines in the city run over some portion of the Main Street track through the retail district, and thus the traffic passing the intersection of Main and Portage streets reaches 185 cars an hour. The transportation organization includes 600 motormen and conductors and 18 supervisors.

The rates of fare are: Cash fare, 5 cents; tickets six for 25 cents and 25 for $1; workingman's tickets, eight for 25 cents, good week-days from 6 to 8:30 a. m. and 5 to 6:30 p. m. and all day Sunday; school children's tickets, 10 for 25 cents. In 1906 the company was first granted permission to operate its cars on Sundays and the low fares for tickets resulted from the negotiations for Sunday operation. About three-fourths of the receipts are received for tickets. The cash fares last year amounted to $663,000 out of the total gross receipts of $2,623,731. Universal transfers are issued. Each line has a transfer of different color identified by the month, date and a serial number. The distinguishing feature of this transfer, which was illustrated in the issue of Oct. 16, 1909, on page 882, is the use of three vertical columns, one containing the names of the inter-



Winnipeg System—Interior of City Car

secting line, another the hour and the nearest 10 minutes with a space below to be punched for p. m. use, and a third column on the left-hand side of the transfer with a shaded space opposite the name of each connecting line. At the bottom of this column are spaces to be punched for the going direction. The purpose of the column of shaded blank spaces headed "via" is for the validating the transfer for the second use. When a transfer is collectable on a car and the passenger is entitled to continue his journey on another line, the conductor does not collect the transfer and issue a new one, but indicates the second transfer by

a punch mark in the "via" column opposite the name of the line on which he is operating. Each conductor is supplied with tickets and change to the amount of $25.

COLLECTION OF FARES

Fares are collected with the Coleman portable fare box. The executives of the company are fully satisfied with the results from the use of this box, which is in line with the practice of many other street railways of Canada. This fare box is about 2 in. x 4 in. x 8 in. in size. It has a substantial handle on one side and a protected slot in the top. Conductors are not allowed to insert fares in the box and are required to handle no money except in making change. Transfers are not put in the fare boxes. This method of fare collection meets with the approval of the riding public and is not thought to require as much time as would be needed to register fares.

When a man starts on his run in the morning he signs for a fare box and retains it until his relief; then the box is turned in to the receiver and the conductor's signature made at the time of getting the box is checked by the cashier so that a record may be had of the return of all boxes. In turning in a box at his relief a conductor inserts in the hollow handle of the box a small report noting the route, car number, box number, date and conductor's number. After relief, when the conductor starts on his next run, he signs for another fare box, which is checked off when turned in at the end of his run. At night he makes out his transfer ticket report and indicates thereon the identification numbers of the boxes which he has used during the day. When the fare boxes are received they are taken to counting tables where each is opened separately and a record is made of its contents in cash and tickets of various kinds. A force of 9 or 10 girls does the counting.

The platforms of the Winnipeg cars are arranged with a dividing railing to separate the in-and-out traffic. When these railings were placed on the cars it was found possible to shorten the time on some runs because of the reduction in the length of stops. Smoking is not permitted on the cars and no passengers are allowed to stand on the platform if there is room within the car body.

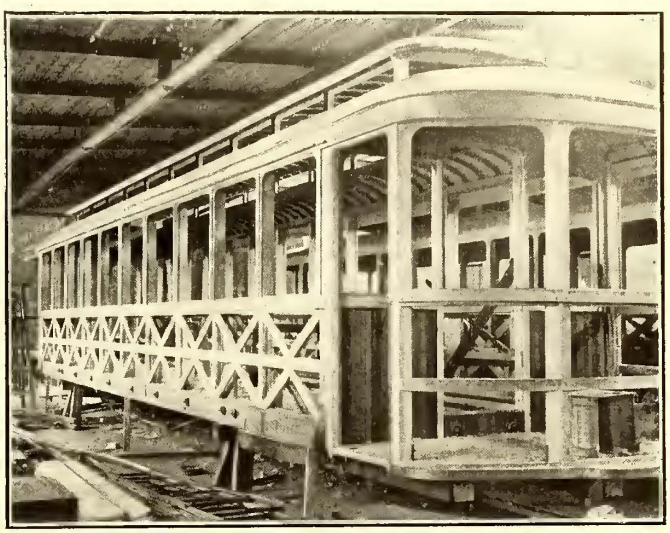
RIVER PARK

The railway company owns a park of 200 acres located on the Red River at the south end of the city. This park has been developed to afford the usual amusement features and to encourage picnic parties. No liquors are sold, but other refreshments may be purchased and the railway company supplies hot water for making tea. One of the chief attractions of this park is the section devoted to wild animals. Here are found deer, buffalo, bear, Rocky Mountain goats and many other interesting animals of the Canadian Northwest.

Winnipeg System—Repair Shops

ROLLING STOCK

The rolling stock equipment of the Winnipeg Electric Railway includes 175 closed, double-truck, 40-passenger motor cars, 13 open cars, three sweepers, one Ruggles rotary snowplow and a complement of line and work cars. The company is prepared to build all of its cars. Last year 30 double-truck city cars were built, and this year a similar order is in course of construction in the shops. The standard city passenger car is 32 ft. long over body, 45 ft. long over vestibules, 8 ft. 4¼ in. wide over sheathing and 13 ft. high from top of rail to trolley base. The car body is carried on an underframe made up of two 7-in. I-beam center sills and two side sills of wood 6 in. x 8 in. in section. The needle beams are 7 in. deep. All bodies are built for single-end operation and have front platforms 4 ft. long and rear platforms 7 ft. long. The platforms are supported by four angle-iron knees ½ in. x 5 in. x 5 in. in section, which extend to the bolster. An accompanying illustration of one of these car bodies shows the step and platform arrangement. The steps leading to the rear platform are 6 ft. long and are subdivided by a stanchion and pipe rail which serve to divide the incoming and outgoing passengers. The front vestibule is entirely enclosed, and is reached by the motorman through the usual bulkhead door and also a swinging side door.



Winnipeg System—Car Under Way in the Company's Shops

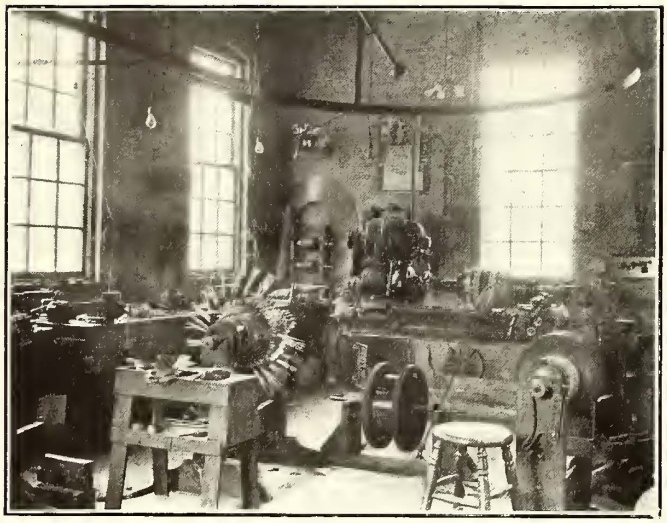
The general design of the upper structure of the Winnipeg standard car is illustrated. Large windows are provided on each side of the car body, which is framed of ash. The upper deck is supported by continuous steel carlins at each window post. Below the window rail the bodies are sided with narrow matched strips of cherry filled with oil, rubbed and varnished in its natural color. The belt rail and window posts and upper woodwork of the body are painted cream color. A guard rail of 1¼-in. pipe is placed along the outside of the car close to the bottom of the sheathing. This pipe is supported firmly in malleable castings and serves to protect the varnished wood from being injured by wagons.

Storm sash are provided for all the windows, including those of the vestibule. The glass in the window sash is 32 in. x 34 in. in size. No curtains are provided in the city cars, except for the windows and door of the front bulkhead. The sash are arranged to drop in pockets. Wire net window guards are provided for the blind side of the car. The upper deck has 10 hinged sash on either side. The deck rails are reinforced by ½-in. truss rods extending from end to end of the body and supporting the clerestory structure from below by three queen posts. The car body is provided with a fir floor of single thickness covered with maple slats. The platforms have double floors of maple.

Longitudinal seats are provided with deep cushions covered with dark-red plush, which presents an attractive appearance in combination with the cherry finish. The seating capacity is sufficient for 40 passengers, and within the unobstructed center of the car there is a large space for standing passengers. The interiors of the car bodies are illuminated by 20 16-cp lamps

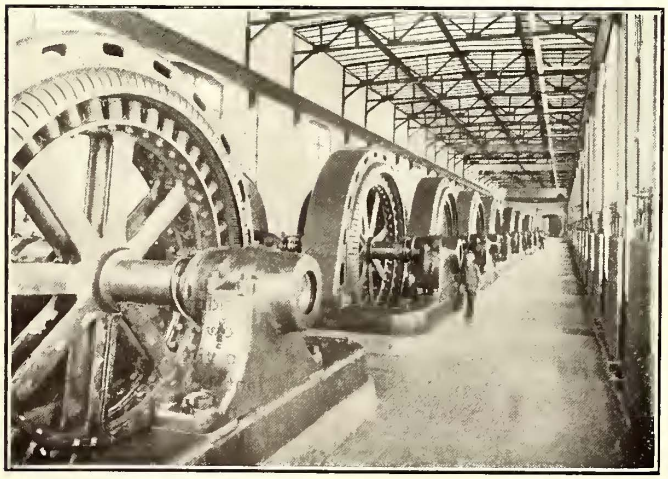
arranged 10 along the center of the upper deck and five above each sign rail. The interior hardware and fittings are bronze and were manufactured by the Ottawa Car Company. A push button is provided at each window post.

The truck-center distance is 22 ft. and trucks of Brill, Baldwin and Curtis design are used. Those cars built within the last two years are mounted on Brill trucks. Steel wheels of Carnegie and Midvale manufacture are placed on axles 4 in.



Winnipeg System—Armature Department

and 5 in. in diameter. The wheels are 33 in. in diameter, have treads 3 in. wide and flanges ¾ in. deep. The air-brake equipments used are manufactured by the National Brake & Electric Company and the Westinghouse Traction Brake Company. K-6 and K-28 controllers are operated with the four GE-80 motors. The fenders are of local design and manufacture. They are of the protruding type and are provided with an automatic trip. In addition to the fender a guard made of strap iron or heavy netting encloses the entire space under the front platform and ahead of the forward truck. Some of the special fittings and parts used on these cars are as follows: Roller designation signs; Peacock hand brakes; Consolidated electric heaters; Ohio Brass Company sanders, and Kalamazoo trolley wheels. The type of car body here described weighs 20,000 lb. and the car complete weighs 47,000 lb.



Winnipeg System—Interior of 30,000-Hp Hydroelectric Station at Lac du Bonnet

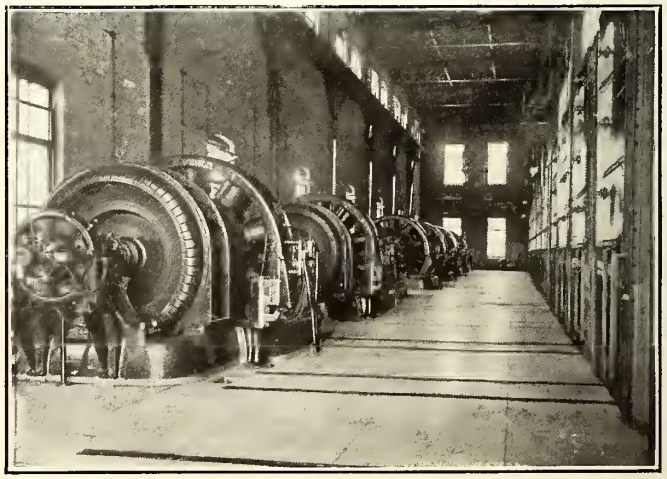
CAR CONSTRUCTION AND REPAIR SHOPS

In addition to the car construction shops, which are located at the south end of the city on a property of 35 acres, the company has a large operating car house and repair shop close to the business district, and a car house with three tracks at the north city limits. The latter structure is now being increased in size so that it will have eight storage tracks within a fireproof building of brick, concrete and steel. The car construction shop is used only for building new cars and making extensive repairs to old equipment. The group of shop buildings includes divisions for carpenter, paint, wood and blacksmith work and has an equipment of good tools. In connection with these shops, which are built of brick, is a sheet-steel car-storage house with nine tracks, each 300 ft. long. Forty men are employed in the car-building shops and the output for the last two years has been one double-truck city or high-speed interurban car every two weeks. A view of a double-truck city car body in course of construction is shown.

Other illustrations present the interior and exterior appearance of the Fort Rouge operating car house and general repair shop. This building includes 12 storage tracks, 175 ft. long, at the front end, and machine and electrical shop, storeroom and an office section at the rear. The buildings are located on the same property with the steam relay station, which supplements the hydroelectric power equipment. The mechanical department employs 125 men, 40 of whom are engaged in car construction, and 85 in maintenance of equipment.

The car repair shop subdivision devoted to electrical work also is illustrated. This is a well-lighted room equipped for testing and repairing motors and control apparatus. A chain block supported from an elevated runway encircling the room, serves for handling heavy parts. The equipment of the electrical shop includes a direct-driven American lathe used for general work, several home-made winding tools, field and armature testing sets and a large bake oven. This oven is built of brick and is 10 ft. x 14 ft. in floor area and 8 ft. high. Its opening into the electrical repair-room is provided with double steel doors. The oven is heated with 10 car heaters and a ventilating duct is provided to carry away the gases. A steel truck has been built especially for carrying armatures and motor coils in and out of the oven. It is the practice to slot all commutators to a depth of ⅛ in. This work is done by hand with a hacksaw. The freedom from grades and the high character of the repair and inspection work are illustrated by the fact that only three men are required to care for the electrical shop repair work on 750 motors.

The machine shop equipment is in a bay at one side of the car repair floor. At this point the repair shop is 12 tracks wide. The tool equipment of the machine shop includes a large wheel-



Winnipeg System—Main Sub-Station with Step-Down Transformers and Railway Motor-Generator Sets

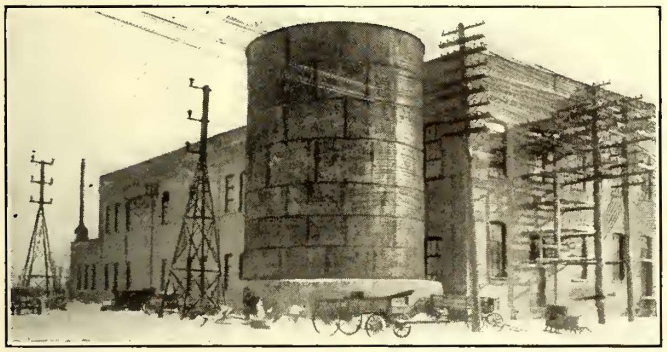
turning lathe, built by John Bertram & Sons Company, Dundas, Ontario. This lathe is direct-driven by a 15-hp motor. Three other lathes for general work, hydraulic wheel press, several drilling and boring machines and smaller tools are group-driven by an Edison bipolar motor. The blacksmith shop has four forges and a power hammer.

POWER SUPPLY

In 1906 the Winnipeg Electric Railway put into service a

water-power generating station of 30,000-hp capacity located at Lac du Bonnet, on the Winnipeg River, 65 miles from Winnipeg. Previously the railway and lighting power had been supplied from the central steam station, described later. This station is now held in reserve. The hydroelectric station is connected with a large receiving station in the city by a 60,000-volt, steel-tower transmission line carrying duplicate circuits. The normal daily peak load carried is 20,000 kw, including street commercial and residence lighting, six railway substations and both a. c. and d. c. power. Curves showing the afternoon and evening load for all these services except the d. c. commercial power, are presented.

The transmission plant has furnished current for nearly four years with a total interruption of but 25 minutes, except at the time of an accident to one of the penstocks, which occurred last November. The continuity of service over a 65-mile line through an undeveloped territory is credited to the stability of



Winnipeg System—Main Receiving Station and Sub-Station

heavy steel towers and to careful inspection. Two No. 000 circuits are carried by the line of towers, and switch-over facilities are provided so that repairs can be made to one circuit while the other is under load. The whole line is inspected daily by a crew of patrolmen. Each man is responsible for a 12-mile section and rides over his section on horseback. Two pairs of telephone wires connect the generating station and the receiving station at Winnipeg. One line is carried on the steel towers and the other on wooden poles. The long-distance transmission line from the hydroelectric plant terminates at a large receiving station located close to the commercial center of the city. From this station current is distributed for railway, lighting and commercial services.

STEAM RELAY STATION

The old steam generating station which furnished current for the railway and lighting service of the city before the construction of the hydroelectric plant burst and necessitated shutting down the whole plant for six days; the steam railway station was called upon to handle a great overload. In fact, the power demand for railway, lighting and commercial use had become so largely in excess of the demand four years ago when the water-power plant assumed the load that it was impossible for the older relay station to generate sufficient current to handle both railway and lighting service simultaneously. The water-power plant was flooded and thus conditions had to be met as best they could with the old steam equipment. To do this set periods were announced when current would be furnished for railway, lighting and commercial use. The street cars were operated from 6 to 8:30 a. m. and from 4:30 to 7:30 p. m. The commercial power customers were furnished with current from 8:30 a. m. to 4:30 p. m. and from midnight to 5 a. m. Full lighting service was given from 7 until midnight. The Board of Trade and City Council approved of this emergency schedule for furnishing current, which, it will be noted, was arranged to prevent the overlapping of the peaks of

Winnipeg System—Daily Load Curves of all Circuits

the railway, lighting and commercial services and thus permit the steam relay station to give nearly full service to each during its appointed hour. An account of the unusual accident at the water-power plant was published in the issue of the ELECTRICAL RAILWAY JOURNAL for Dec. 25, 1909.

The steam relay station building is in three sections: a boiler house, an old engine-room and a new engine-room. The plant is located on the same property with the railway company's general repair shop and is situated on the bank of the Assiniboine River, from which stream circulating water is obtained. The present boiler equipment is made up of 2800 hp in B. & W. and 1500 hp in Heine boilers. In addition to these six 500-hp B. & W. boilers are being installed so that the plant will have a total of 7200 boiler-hp capacity. The older boiler equipment had two brick stacks and a Sturtevant induced draft fan equipment. The new boilers will exhaust into a new stack 8 ft. in diameter and 125 ft. high. In the enlargement of the boiler plant and the rearrangement of the equipment, which is now under way, coal bunkers will be built over the firing aisle and a chain-belt conveyor will be installed to handle ashes and coal.

Winnipeg System—Downstream View of Hydroelectric Station

In the new engine-room are two direct-driven 800-kw, 60-cycle, 2200-volt generators connected to Goldie & McCullough cross-compound engines, which are operated condensing, and with an initial steam pressure of 125 lb. One of the generators is of Allis-Chalmers-Bullock manufacture and the other was built by the Canadian General Electric Company. Every two

weeks these engine-driven units are brought up to speed and run in parallel with the Lac du Bonnet hydroelectric plant. The direct-driven units in the new engine-room are served by a 30-ton capacity Whiting traveling crane.

The older part of the generating machinery includes the following lighting and railway apparatus: One 600-kw and two 325-kw, 2200-volt flywheel generators with marine engines; one 400-kw, one 850-kw and one 500-kw direct-current railway generators driven by cross-compound engines manufactured by the Laurie Engine Company, Montreal. Another cross-compound engine drives a shaft fitted with a friction clutch to which are belted two 75-kw a. c. generators and four 50-kw d. c. generators. These machines are so arranged in connection with the shaft and clutch that the engine can be disconnected conveniently and the generators run as a motor-generator plant to assist the a. c. or d. c. generating equipment according to load demands.

RAILWAY SUBSTATIONS

The railway equipment at the main substation includes three 800-kw General Electric motor-generators sets, shown in the interior view of the station. The rail distribution feeder and trolley wires are supplied with 550-volt current from the main receiving substation and from three smaller new substations which are built for railway use only. The smaller substations are located at the north, west and south city limits. Two of these stations are equipped with 1000-kw units and the third with an 800-kw unit. The substation at the north city limits supplies current for city lines and for the southern end of the Winnipeg & Selkirk interurban railway. The substation at the west limits supplies current for the Portage Avenue division of the city system and for the 12-mile suburban line to Headingly. The substation at the south end of the city supplies current for the city lines only, and is located not far from the company's amusement park on the Red River.

The park substation building is 24 ft. x 42 ft. in ground dimensions and 21 ft. 6 in. high from machine-room floor to ceiling. The building has a basement under the entire structure and the machine-room is served by a 10-ton, hand-operated Whiting crane. Space is provided for two motor-generator sets, but one of which has been installed. This set is made up of a 2200-volt, 60-cycle synchronous motor driving a 1000-kw G. E. 500-volt interpole generator. Alternating current at 2200 volts is fed to the substations by an overhead line from the receiving station.

The railway substations were all designed and built by the engineers of the Winnipeg Electric Company. They are of a thoroughly fireproof construction employing reinforced concrete for floors, foundations and roofs, yellow brick for walls and metal window sash and casings. The only combustible material in any of these structures is a single wooden door.

CENSUS REPORT ON MUNICIPAL ELECTRIC LIGHTING STATIONS

According to the census report on central electric light and power stations there were in the United States in 1907, 1252 municipal, electric light and power stations. Of these 150 were in the North Atlantic States; 158 in the South Atlantic; 727 in the North Central; 166 in the South Central and 51 in the Western States. Most of these municipal stations are in places of small population, nearly seven-eighths of the total number being located in places of less than 5000 population and less than 3 per cent in places having a population of 25,000 and over. In the three divisions—the South Atlantic, the South Central, and the Western—together only one station was reported in 1907 for cities of over 100,000 population. In the North Atlantic division there were 16 cities of this class, with only two municipal plants in 1907; and in the North Central, 14 cities, with 9 municipal plants. The one station reported for the South Atlantic division was in Baltimore, while the four stations in the "500,000 and over population" class of cities in the North Central division were all located in Chicago.

POWER ECONOMY IN ELECTRIC RAILWAY OPERATION—COASTING TESTS ON THE MANHATTAN RAILWAY, NEW YORK*

BY H. ST. CLAIR PUTNAM.

Engineers have long recognized that a material saving in power could be realized in electric railway operation if the motormen could be induced or trained to operate the trains in a manner approximating the speed-time curve used in the

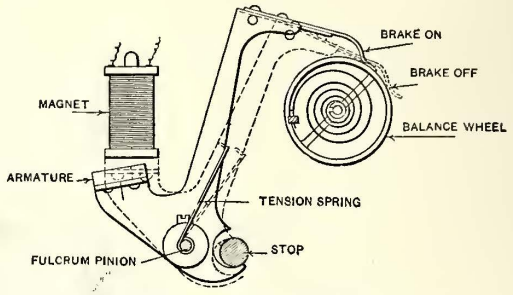


Fig. 1—Coasting Tests—Clock Mechanism

preliminary calculations. It is proposed in this paper to describe some tests made on the Manhattan elevated division of the Interborough Rapid Transit Company, New York, in which a clock was used to record the amount of coasting employed in the operation of trains, the object of this device being to obtain from the motormen a better manipulation of the trains with the resulting economy in the use of power.

The clock consists of a mechanism of the type manufactured

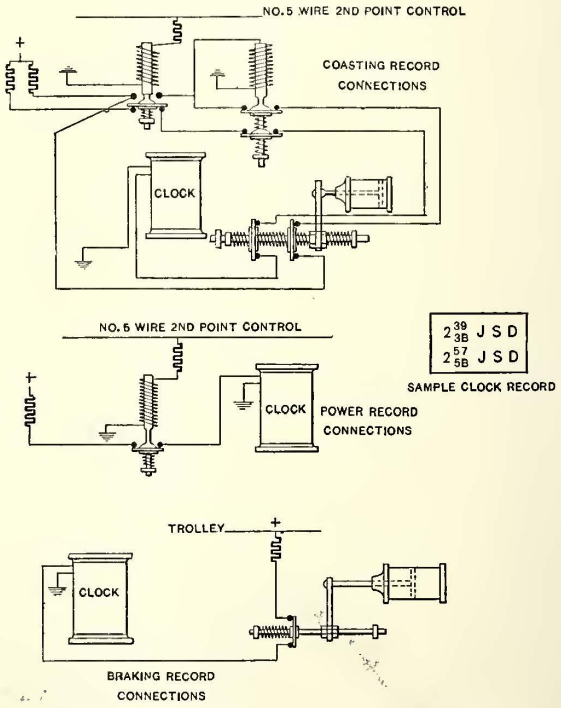


Fig. 2—Coasting Tests—Clock Connections

for recording the time of employees. To the balance wheel escapement a braking device has been added, as shown in Fig. 1, which is lifted free from the balance wheel by an electromagnet which is energized only during the coasting of the train. This permits the clock to record the coasting time only. Each motorman has an individual key which he inserts on taking charge of the train and again on leaving. The turning of this key records his number or initials and the time as shown by the clock mechanism; the difference in the time between the two records made by the key represents the total time of

*Abstract of a paper presented at the Twenty-seventh Annual Convention of the American Institute of Electrical Engineers, Jefferson, N. H., June 28-July 1, 1910.

coasting during his run. The slip record is torn off by the motorman and turned in to the proper official. This is checked up with his running time, and the motorman is rated according to the percentage that the coasting time is of the total time of his run, allowance being made for schedule variation.

The electric circuits controlling the clock are interlocked with the master controller and the brake mechanism and arranged so that the coasting clock will start only after the two actions of turning the power on and then off. The connections used are shown in Fig. 2. The clock is stopped as soon as the air brakes are operated and the brake cylinder has started to move to the braking position. If, for any reason, after the brakes are applied, the air is released and additional coasting obtained before the train stops, this additional coasting is lost from the amount of coasting recorded unless power is again applied. This is not an important factor in normal operation as the actual amount of coasting of this character is small.

SPEED TIME CURVE CHARACTERISTICS

While the principles involved in speed time curve calculations are well understood, the following discussion of the factors entering into electric operation is given to make clear the possible economies from better operation.

Acceleration. The rapid acceleration of trains, providing the schedule speed is unchanged, results in an important saving of power for two reasons, first, the maximum speed reached is less with a high acceleration, and consequently the train resistance is somewhat less; second, and of much greater importance, is the fact that with a high rate of acceleration, the speed at the start of braking is less than with a lower rate and, consequently, the energy absorbed and lost in braking is less. A quick acceleration is one of the most feasible methods of saving power in such service as exists on the Manhattan Railway. Fig. 3 shows the typical average run on the Second Avenue line, using the same rates of acceleration and braking and length of stop as in the original calculations for the electrification of the Manhattan system, but using the train resistance as derived from tests made in 1905. This run as shown is representative of the average run on the Second Avenue line where the coasting clock tests have been made, and is also representative of the average run of the entire Manhattan system. The distance between stations on the portion of the Second Avenue line tested, between Canal Street and 127th Street, is 1768 ft. as compared with 1763 ft. for the entire Manhattan system. In this typical curve the acceleration used is 1.33 m.p.h.p.s. and the schedule speed is

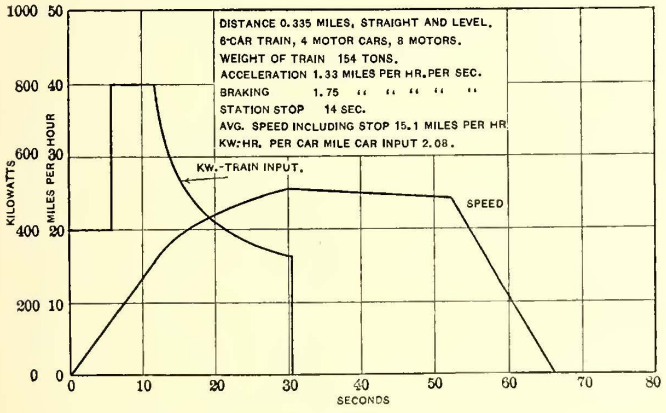


Fig. 3—Coasting Tests—Typical Run

based upon the printed schedule of the road. In Fig. 4 is shown the percentage increase in coasting time resulting from the increase in the rate of acceleration from 0.9 m.p.h.p.s. to 2 m.p.h.p.s., and the resulting decrease in power consumption, based upon an average run on the Second Avenue line. In the tests on the entire Manhattan system conducted on March 22, 1910, the acceleration of different motormen was found to vary from 0.9 m.p.h.p.s. to 1.47 m.p.h.p.s. Providing other factors of train operation remain the same (that is, the braking, running time and time of stop) the increase in the rate of acceleration from 0.9 to 1.47 m.p.h.p.s. will result in an increase in the percentage of coasting time from 0 to 40.5 per cent of the total time, and a saving of 36 per cent in energy consumption. A motorman on the Manhattan system on full runs will average about 600 car miles a day, and the power used at the car with 0.9 acceleration will approximate 2.82 kw-hours per car mile. As between these two motormen, therefore, providing the scheduled speed is maintained, the motorman who accelerated his train at an average rate of 0.9 m.p.h.p.s. will waste during the day 610 kw-hours at the

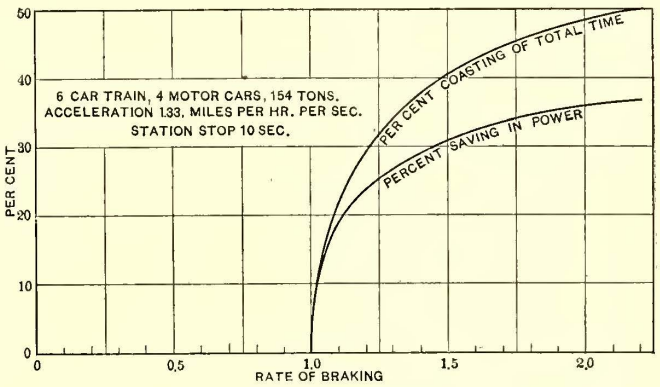


Fig. 4—Coasting Tests—Influence of Acceleration

car. With 80 per cent efficiency to the power house, this becomes 762 kw-hours. In practice the full saving of power resulting from better acceleration is not realized, owing usually to the better running time made by the good operator. This results frequently in his having to wait for the train ahead and by so doing, lose a large part of the savings in power which should follow his good operation. The clock should give, however, a material increase in coasting time under such circumstances, with a resulting saving in power. The men will learn to gage their trains, and instead of stopping for the man ahead, will utilize the surplus time in coasting. However, some penalty must be imposed to prevent the motorman from over-doing the coasting at the expense of the running time.

Series Running. It was found that an increase in the percentage of coasting obtained by reducing the amount of series running does not effect a corresponding saving in power. This is due to the fact that while the total time during which power is applied is increased and the time of coasting reduced by holding the controller in the full series position, say for four or five seconds, the actual power used remains practically the same because the additional power required on account of the longer time of power application is offset in large measure, if not entirely, by the saving in rheostat losses owing to the reduced time that the rheostat is in circuit in passing to full multiple. A limited amount of series running, therefore, is not objectionable, and under certain conditions it is better to run in series for a short time than to pass to the multiple position, especially where power is cut off almost immediately after the multiple position is reached as under certain conditions in approaching a station. The decrease in coasting time resulting from a moderate amount of series running does not, therefore, necessarily represent an increase in power consumption, unless the series running has been excessive. In this respect the coasting clock will give misleading results; but as under normal conditions there is little occasion for running in series, excepting around curves, the error thus introduced into the record is not important.

Braking. A high rate of braking results in a reduction in power consumption for reasons similar to those existing as to the rate of acceleration. It permits the power to be cut off at an earlier point, a longer time of coasting introduced, power otherwise wasted in the brakes to be recovered and the train brought to a quick stop. Perfection in braking is much more difficult of attainment than acceleration, as the train must be stopped at the station within a space limited to a few feet. Many motormen feel their way into stations, with a

material increase in the power used if schedules are maintained.

In Fig. 5 is shown the percentage of power saved on account of the increased percentage of coasting introduced by increasing the rate of braking from 1 m.p.h.p.s. to 2.25 m.p.h.p.s. These limits are frequently found in the operation of Manhattan trains. Carefully conducted tests have shown 2 m.p.h.p.s. to be entirely practical. An increase in the rate of braking

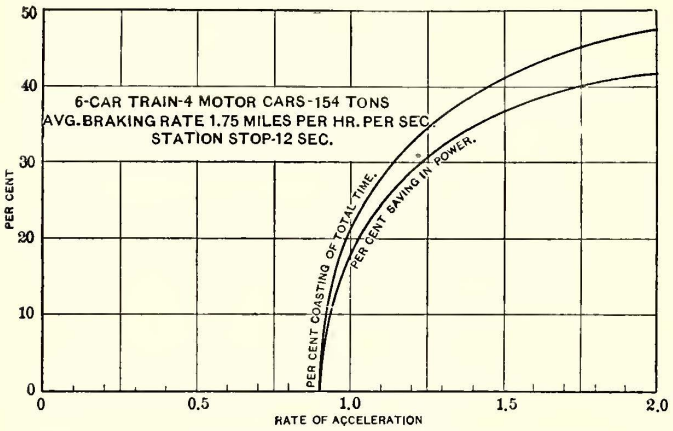


Fig. 5—Coasting Tests—Influence of Braking

between the limits of 1 m.p.h.p.s. and 2 m.p.h.p.s. results in increasing the coasting to 48.5 per cent of the total time with a saving in power of 35.5 per cent.

In the tests made over the Manhattan system on March 22, the trains were not equipped for getting the braking rate. The average time required by the motorman in bringing the train to a stop varied from 10.2 seconds to 20.2 seconds. This would indicate approximate braking rates of 1.15 and 1.90 m.p.h.p.s. The higher rate would increase the coasting time from 26 per cent for the lower rate, to 47.5 per cent, and result in saving approximately 280 kw-hours per day.

Station Stops. On the Second Avenue line, the average run is 0.335 mile and the maximum possible stop with the maintenance of the schedule, and with no coasting, is 16.2 seconds, assuming an average run as typical. A reduction in the time of stop to 10 seconds results in an increase in coasting time to 45 per cent of the total time and a reduction of 40 per cent in the power used.

Coasting. The amount of coasting which a motorman can obtain and still maintain his schedule, is obviously the result of the factors of operation. The theoretical coasting is 27.5 per cent of the total time including stops. It is possible to obtain this amount of coasting and even to exceed it by changes in operation which are entirely within the range of practicability. In Fig. 6 is shown the percentage of change made in these operating factors, and the resulting percentage of coasting obtained, and the corresponding percentage of power saved. It will be noted that it makes but little difference which factor is altered. The percentage of power saved is substantially the same, however the increased coasting is obtained. This, of course, is to be expected. It is well to point out the very large saving in power consumption which results in reducing the stop from say 15 seconds to 10 seconds, assuming that the schedule speed remains the same. This saves 25 per cent in power through increased coasting.

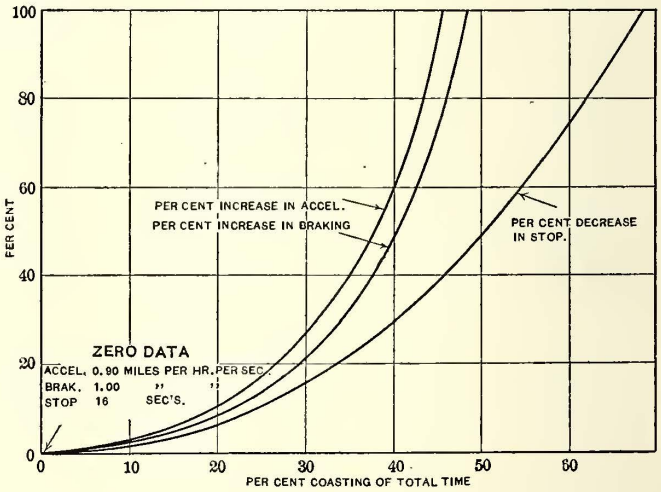
After all trains on the Second Avenue line were equipped with clocks several tests were made, due allowance being made for heaters, lighting, wattmeter calibration, etc. The results obtained were necessarily approximate but were remarkably consistent and showed a material improvement in coasting and also a reduction in the power required for the car operation, namely, an increase in the time of coasting from 10 per cent as it was prior to the installation of the clocks to 38 per cent following such installation, resulted in a saving of 25 per cent in the power required for traction.

TESTS ON ALL LINES

In order to compare the operating conditions existing on the Second Avenue line with the conditions on the other lines of the Manhattan system, on March 22 a test train was run in actual service over all divisions of the Manhattan system. A seven-car train composed of four motor and three trail cars was used. Each trail car was equipped with one of the recording clocks. These clocks were connected as shown in Fig. 2. One clock was used to record the coasting time, the second the time of power application, and the third the time of braking. Stop watch records were also made of the time of series running and total power application, time of coasting, time of braking and time of station and signal stops.

The results of the tests over the Second Avenue line reduced to an average run are plotted in Fig. 7 and are given as "Running Charts" for each of the three tests on this division. These curves approximate speed-time curves in form, but naturally as the different factors which enter into the characteristics of the curve are averages, the resulting curve does not pretend to give the correct area and distance. It simply pictures the average operating conditions of the run.

It will be noted that motorman *S* in test No. 2 obtained 50.5 per cent coasting, the largest amount recorded during the day. Of the three tests on Second Avenue, motorman *O* in test No. 5 obtained the smallest amount of coasting, 41.4 per cent and carried power for the longest time, 31.6 per cent, yet he was the better operator of the two. If he had used the same time in making the run as motorman *S* in test No. 2, it would have been possible for him to obtain as high as 58.5 per cent coasting as shown by the broken line



Percentage change in operating conditions and resulting percentage of coasting

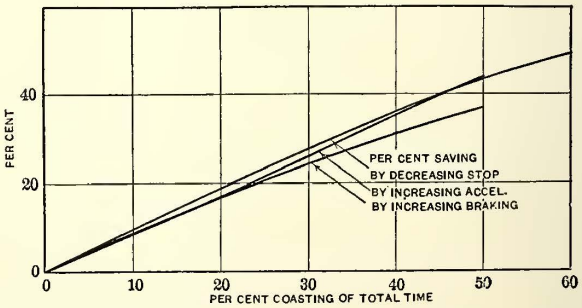
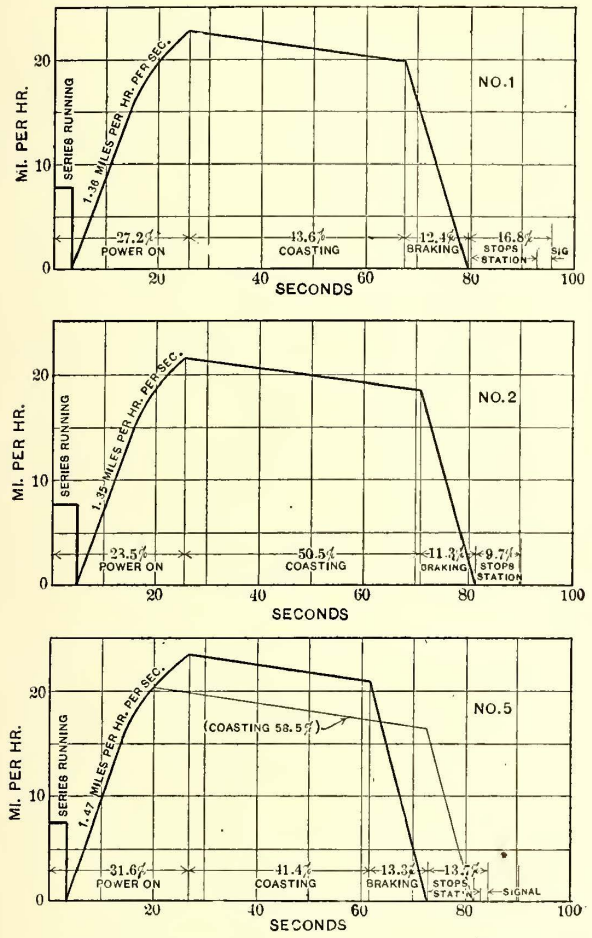


Fig. 6—Coasting Tests—Influence of Various Factors

on test No. 5, and he could have cut his power application down to 22.2 per cent with a saving of 8 per cent in power as compared with motorman *S* in test No. 2. The good results in test No. 5 were obtained with an acceleration of 1.47 m.p.h.p.s. and braking of 1.85 m.p.h.p.s. (approximate) as compared with an acceleration of 1.35 m.p.h.p.s. and braking of 1.75 m.p.h.p.s. (approximate) in test No. 2 The rate of braking indicated on these curves is approximate only, as the average braking includes the signal braking between stations and at curves in addition to the braking at station stops. The slope of the braking curve, however, indicates quite ac-

curately the relative rate of braking used by the motorman. The motormen who operated the trains in the tests on the Second Avenue line were selected men and the runs were made to illustrate what could be accomplished after a thorough training of several months. The average coasting obtained in the three runs is 45.2 per cent, corresponding to 1.70 kw-hours per car mile at the car. This indicates a saving in



No. 1. Typical running chart, 129th Street to South Ferry—8:01:20 a. m. to 8:40:43 a. m.—Motorman S—Schedule time 35 min.—27 runs—Average run 1723 ft.—Average speed 12:3 miles per hour.
No. 2. Typical running chart, South Ferry to 127th St.—8:45:20 a. m. to 9:24:23 a. m.—Motorman S—Schedule time 34.5 min.—26 runs—Average run 1752 ft.—Average speed 13.2 miles per hour.
No. 5. Typical running chart, 129th Street to South Ferry—1:23:15 p. m. to 2:0:45 p. m.—Motorman O—Schedule time 35 min.—27 runs—Average run 1723 ft.—Average speed 13.9 miles per hour.

Fig. 7—Coasting Tests—Running Charts

power consumption amounting to 34 per cent as compared with the conditions existing on this line prior to the installation of the clocks. This, of course, is in excess of the average saving of all the men as these men were specially selected.

In the Third Avenue tests, the run south was made with the motorman whose turn it happened to be. This run showed 13.2 per cent coasting. The run north was made with an experienced man and showed 27.6 per cent coasting. The difference was due mostly to the difference in the rate of acceleration, but partly to the braking rate and partly to an excessive amount of series running in the third test. These two runs showed an average of 20.4 per cent braking which indicates 2.22 kw-hours per car-mile at the car. These men, therefore, used 30.6 per cent more power than was used by the men on the Second Avenue test.

For the two tests made on the Sixth Avenue line, the motormen were taken as they come, and their handling of the train was in fairly close agreement. On account of the number of turns on this line, the amount of necessary series running was considerably in excess of that obtained on the other lines. The average coasting obtained was 22.3 per cent. This corresponds to a power consumption of 2.17 kw-hours per car-mile. As compared with the average obtained in the Second Avenue tests, this represented an excess consumption of power of 27.7 per cent.

For the Ninth Avenue tests the motormen were taken as they came, and as in the Sixth Avenue tests, the trains were run very much alike. In both cases the acceleration was poor and the braking somewhat below the standard. Both used a large amount of series running. The Ninth Avenue line is an ideal one on which to obtain a large amount of coasting on account of the longer runs, easy schedule and long grades, yet the coasting obtained by these two men was but 18.9 per cent and 21.2 per cent, respectively, and averaged 20.1 per cent. As compared to the average obtained in the Second Avenue tests, this represents an excess consumption of power of 31.8 per cent.

CLOCKS RECORDS ON ALL LINES AND RESULTS

In the tests conducted on March 22, the motormen were conscious of being under observation by the test crew as well as by their own road officials, and under such circumstances they naturally tried to do their best. The results obtained, therefore, cannot be regarded as representative of actual conditions, but can be taken as fairly representing the best that these men could do, and, therefore, as illustrating the knowledge of the motormen in general. The tests were too few in number, however, and the conditions under which they were made were such that they are not regarded as representative. To determine the fair average conditions as to coasting existing on all divisions of the system, tests were made on the Second and Third Avenue lines last fall and two trains equipped with clocks were put in regular service this spring on the Sixth and Ninth Avenue lines.

The average of these results should be fairly representative of the coasting conditions at present, as well as prior to the installation of the coasting clock on the Second Avenue line. The men soon become aware of the trains equipped with clocks, however, and consequently are more careful in the operation than usual. It is probable, therefore, that the coasting data obtained from these tests are above rather than under the average conditions. A coasting summary of the coasting data for all lines follows:

SUMMARY—COASTING DATA

	Car miles per day.	Per cent coasting.
Second Avenue	28,863	10.0
Third "	79,403	10.2
Sixth "	46,571	11.9
Ninth "	33,826	19.1
Average	188,663 (total)	12.2

In the table below is given the average coasting obtained during five weeks on the Second Avenue line, where the coasting clock has been in service for slightly over three months. The average run on this part of the Second Avenue line, as already pointed out, closely approximates the average run for the entire Manhattan system.

SECOND AVENUE LINE—COASTING DATA. COASTING CLOCK INSTALLED FOR THREE (3) MONTHS

			Average running time	Average coasting time	Per cent coasting
Week ending	March	5	28.7	10.5	36.8
" "	"	12	28.7	11.1	38.8
" "	"	19	28.5	10.8	37.7
" "	"	26	28.5	10.6	37.0
" "	April	2	28.4	10.1	35.4
	Average		28.6	10.6	37.1

The result of these calculations and tests shows that an increase in the percentage of coasting from 12 per cent to 37.5 per cent as shown above, will effect a saving of 24 per cent in the power required for traction.

Coasting is the recovery of power already used, and, hence, is the key to the problem. The coasting clock, therefore, gives a direct measure of the power recovered by the motormen and as this recovery can also only be made by cutting off the power application sooner, it is believed that it is the most effective element in train operation to measure. At the same time it concentrates the motorman's attention on that operating element which is the direct reason for saving power.

THE DESIGN OF THE ELECTRIC LOCOMOTIVE*

BY N. W. STORER AND G. M. EATON

The features to be embodied in an ideal electric locomotive depend entirely on the point of view. The man who is responsible for hauling trains on schedule time sees in the electric locomotive only a means for keeping trains moving on schedule time. His conception of efficiency is represented by the number of trips made on schedule time, divided by the total number of trips. He accepts an electric locomotive only as a last resort, and then recommends the incorporation of as many as possible of the features of successful steam locomotives. The eyes of the motive power man see much the same features as those of the operating man, but his eyes magnify details of design in a greater degree. Both will insist on the strength of all parts being ample to withstand every phase of the service such as bumping, speeding, overhauling, etc. Their ideal locomotive will operate safely at high speed, in either direction. It will be able to make up a reasonable amount of lost time, and will always be ready for service. It will not require long layovers, and will be in the shop the least possible time. They would like, if possible, a single type of locomotive which would perform any service that might be required of it, from making up and hauling a 2500-ton freight train to making a high-speed run with a "limited." The amount of power consumed and the excessive weight involved in an interchangeable locomotive of this type are a matter of little importance to them. To the general manager or president the cost of the locomotives will appeal most strongly.

At first sight it appears to be a very simple problem to transmit the power from rotating motor armatures to rotating wheels. However, there are more or less serious objections and limitations to every type of transmission that has been proposed. These include:

a. General motor with armature pressed on driving axle. "New York Central."

b. Gearless motor with armature carried on a quill surrounding axle and driving the wheels through flexible connections. "New Haven passenger."

c. Geared motor with bearings directly on axle and with nose supported on spring-borne parts of locomotive. "St. Clair Tunnel."

d. Geared motor with bearings on a quill surrounding axle, and (1) nose supported on spring-borne parts of machine (New Haven motor car) and (2) motor, rigidly bolted to spring-borne parts of machine, the quill having sufficient clearance for axle movements. "Four-motor New Haven freight."

e. Motor mounted rigidly on spring-borne parts, armature rotating at same rate as drivers, power transmitted to drivers through cranks, connecting rods and countershaft on level with driver axles. "Pennsylvania."

f. Motor mounting and transmission as in (*e*), but motor fitted with double bearings, one part for centering motor crank axle and the other for centering the armature quill which surrounds and is flexibly connected to the motor crank axle. "Two-motor New Haven freight."

g. Motors mounted on spring-borne parts, armature rotating at same rate as drivers, power transmitted to drivers through offset connecting rods and side rods. "Latest Simplon locomotives."

h. Motors mounted on spring-borne parts, armature rotating at same rate as drivers, power transmitted to drivers through Scotch yokes and side rods. "Valtellina locomotives."

j. Motors mounted rigidly on spring-borne parts, power transmitted through gears to countershaft, thence to drivers through Scotch yokes and side rods.

Further classification of electric locomotives on the basis of framing and wheel arrangement is also of assistance in gaining a clear understanding of existing locomotives.

a. Cab and framing an integral structure. All weight carried on drivers. Drivers contained in a single rigid wheelbase. "St. Clair Tunnel."

b. Cab and truck framing separate structures, all weight carried on drivers. Drivers contained in two rigid wheelbase trucks. Draw-bar pull transmitted through center pins or through truck frames. "P. R. R. 10,001 and 10,002."

c. Same as (*b*), but with added idle wheels for guiding and weight carrying. "Modified New Haven passenger and New Haven freight."

d. Any of the foregoing forms permanently coupled in pairs or articulated. "Pennsylvania."

e. Same as (*a*), but with added idle wheels for guiding and weight carrying. "Valtellina or New York Central."

f. Cab and framing an integral structure. All weight carried on drivers. Driver wheelbase partly rigid and partly flexible. "Simplon Tunnel."

From an operating standpoint it would be very desirable to have one locomotive which would be capable of handling at the desired speed any train from the heaviest freight to the fastest limited. While such a locomotive can be built, it would have a prohibitive cost. Where the weight of trains to be handled and the speeds at which they operate vary as widely as they do on most trunk lines, an absolutely interchangeable locomotive is impracticable.

SERVICE REQUIREMENTS

In switching service the locomotive operates to a great extent over the curves and special work. This track construction is expensive and hard to maintain. The locomotive should, therefore, embody primarily in its design such features as will enable it to negotiate this kind of track with the least effort. The features are:

(*a*) Short rigid wheelbase.

(*b*) Minimum dead weight per axle.

(*c*) Minimum total weight per axle needed for adhesion.

(*d*) Concentration of weight near midlength of locomotive, and short cab overhang.

(*e*) Effective equalization, preferably of the three-point type.

(*f*) Flexibility of framing under longitudinal twist to assist equalizing system.

(*g*) High center of gravity. While this is of helpful tendency it is probably not worth the expenditure of much money or weight on account of the slow speed of operation.

These features tend to produce a locomotive whose wheels may be deflected by the rails with the least attendant movement of the mass of the locomotive.

Most of the transcontinental railroads are to-day limited in their carrying capacity by long mountain grade divisions. The present practice is to run the heaviest freight trains that can be operated over these divisions. This service is now handled by consolidation or mallet steam engines, which haul 2000-ton to 2500-ton trains at 8 m.p.h. to 10 m.p.h., and electric locomotives are expected to handle the same or heavier trains at higher speeds to increase the capacity on the line.

The type of locomotive best suited for slow heavy freight service, with speeds of 12 m.p.h. to 15 m.p.h. is one having a motor geared to each axle. The feature of prime importance in the design of these locomotives is the absence of weight in excess of that necessary for adhesion. Every ton of excess weight in the locomotive means a ton less trailing load. A slow-speed freight locomotive should be designed with all weight on the drivers. A greater dead weight per axle can probably be tolerated than is wise in switching service. If complete spring support of the motors can be achieved without excess total weight, then the decrease in maintenance charges should much more than offset the increased first cost attendant upon such spring support.

The wheelbase of the slow-freight engine should be as flexible as possible so as to curve easily and prevent flange wear, and should take switches and turnouts without undue stress on the track. No idle leading or trailing truck axles are necessary. The remarks on high center of gravity, equalization, concentration of weight at midlength of engine and flexible framing apply almost equally on switching and slow-freight services.

* Abstract of paper presented at the annual convention of the American Institute of Electrical Engineers, Jefferson, N. H., July 1, 1910.

Trunk lines which are able to operate freight trains at speeds of 30 m.p.h. to 40 m.p.h. require a locomotive with a range of speed from 30 m.p.h. to 60 m.p.h., which is well suited to handle both freight and all but the highest-speed passenger trains. The high speed makes it advisable to provide leading wheels of small size and light dead weight to assist in guiding and to iron the rails down gently to an actual bearing surface on the roadbed and thus avoid the knocks attendant on hammering the free rail down with the heavy drive wheel.

The most important requisite of a locomotive designed to operate at 60 m.p.h. and over is its ability to run at the highest speed without injury to the track. Extensive speed tests have shown that almost any kind of a locomotive will stay on the track at 40 m.p.h. without serious damage to tangent track. As the speeds increase the bad riding qualities rapidly appear, due principally to lateral forces set up.

There are certain features that tend to reduce the intensity of the lateral forces on the track. First is "high center of gravity." The higher the mass of the locomotive is placed above the axles, the less will be its restraining influence against lateral motion on the part of the wheels. The mass of the locomotive may take the general direction of the track, while the wheels follow all the little irregularities in its surface and alignment.

Assume that a locomotive is running at high speed on tangent track and that some rail defect imposes a sudden transverse movement upon the wheels. The mass of the wheels and axle and any other masses rigidly associated with them will deliver a shock approximating a hammer blow to the side of the rail head.

The blow delivered by the spring-borne parts of the locomotive is radically different from this in both low and high center of gravity machines. In the case of a locomotive whose center of gravity of spring-borne parts is at the same height as the center of the transverse restraint, i.e., about the center of the axle, the transverse movement of the leading driver would impose a rotation of spring-borne parts about a vertical axis. The lateral force necessary to produce such a movement would be very great, due to the great moment of inertia about this axis. In the case of a locomotive whose center of gravity is high above the center of transverse restraint, the movement of the spring-borne masses by transverse movement of the leading driver is a composite of two rotations, viz., about a vertical axis and about a horizontal axis parallel to the rails. As the moment of inertia about the latter axis is much less than that about the former, it is evident that the lateral forces involved in the high center of gravity machines will be less. The forces opposing rotation about the horizontal axis are provided by the semi-elliptic riding springs, which will transmit their resultants ultimately to the running face of the rail and will not aggravate flange pressures. Were it not for the dampening effect of the friction of the semi-elliptic springs and the internal friction of the machine, this rotation about a horizontal axis would be a simple harmonic vibration. The period and amplitude of this vibration would be functions of the characteristics of the semi-elliptic springs and of the polar moment of inertia of the masses moved.

Suppose, for example, that with the low center of gravity locomotive first considered, some combination of lateral springs were applied which would impose on the spring-borne weights a vibration about the vertical axis of period and amplitude and dampening action identical with that occurring on the high center of gravity machines. There being no rotation about the horizontal axis, the forces required to control the vibration would be greater than with the high center of gravity machine, because of greater moment of inertia about the vertical axis; and, further, the transverse rail stresses would be greater because the reactions of the controlling forces are transverse. Probably transverse springs as heavy and with as great amplitude of motion as the semi-elliptic riding springs would be none too powerful to perform the required service, and it should be noted that their friction is almost as important as their spring action. Production of an ideal high-speed, low center of gravity engine of the type noted, while perhaps theoretically possible, is attended by difficulties which are serious even if they are not insurmountable.

Considering further the horizontal rotation of the spring-borne masses of a locomotive with medium height of center gravity, there is a zone that is neutral as regards transverse motion relative to the track. If in such a locomotive certain of the lower masses were hung from longitudinal trunnions located on the center line of the locomotive and in this neutral zone, it is evident that the rotation of the spring-borne masses would be more easily accomplished, due to the lessening of the masses moved. Possibly gearless concentric motors could be hung in this way, in connection with a drive of sufficient flexibility to allow free wheel play.

This is not a combination that could be recommended solely because of good riding qualities. It is, however, entirely possible for such a machine to have sufficient attendant simplicity to make it a better compromise than an engine where simplicity and mechanical efficiency are directly sacrificed to secure high center of gravity. The New Haven passenger locomotives have a motor mounting that approximates this condition. There is not as great amplitude of springs to allow unrestrained wheel play either vertically or laterally as might be desired, but there is enough to cushion all blows that the track receives from the mass of the motors, and the reports of track maintenance since the addition of the leading wheels eliminated the nosing tendency, are very gratifying.

Almost equally advantageous with the high center of gravity is the concentration of the mass of the locomotive about the center of gravity, both vertically and longitudinally. It is conceivable that if the mass of the locomotive could be so concentrated longitudinally about the center of gravity as to decrease the radius of gyration about the vertical axis to a value well within the rigid wheelbase, there would be no more serious lateral disturbance on the track with a low center of gravity machine than with one having higher center of gravity, but with a much longer radius of gyration about the vertical axis. Every effort should, therefore, be made to locate the mass of the heavy parts of the locomotive as near the middle as possible.

The action of a low center of gravity locomotive can be very materially improved by locating the point of side restraint below the level of the driving axles. Every inch that this point is lowered is equivalent to raising the center of gravity of the spring-borne parts by an equal amount.

EQUALIZATION

The most successful high-speed steam locomotives of to-day are designed with a three-point equalization, having one point ahead and two trailing. This is apparently a very desirable arrangement for any locomotive, and the electric locomotive designer is at once confronted with a new problem in adapting it to a locomotive which must be designed to operate equally well in either direction. The only means by which the actual three-point equalization can be secured on such an engine is to devise some means for shifting the equalization when the engine is reversed. It is possible to arrange air cylinders interlocked to the reverse lever, which will automatically alter the equalization system, so that a single point of equalization will always lead and two points will always trail. This should, however, be reserved for a last resort, as it does not seem wise to accept such weight and complication unless it proves essential. A symmetrical arrangement of wheels on the two ends of the locomotive has been criticised by some as lending itself to a nosing tendency in high-speed engines. While there is some evidence to support such contention, it is not regarded as absolutely proven.

Whatever system of equalization is used, it is very desirable that the springs on an electric locomotive should be very flexible. This in itself will tend to equalize the loads on the drivers without the complete three-point equalization system. Some of the best engineers contend that a four-point equalization system with flexible springs is better than the three-point equalization system.

INTERCHANGEABLE LOCOMOTIVES

The impracticability of performing all classes of service economically with a single machine is apparent. The locomotive for the heavy high-speed passenger train will require motors of large capacity. This capacity, however, can be utilized only at the high speeds with a corresponding low tractive effort. The electric locomotive is not so well suited for interchangeable service as the steam locomotive because of the fact that its continuous tractive effort is practically constant regardless of the speed at which it is operated. An electric locomotive designed to develop its continuous capacity of 60 m.p.h. if operated in freight service at 30 m.p.h. will be developing only one-half of its capacity. On account of the necessity of having the best riding qualities at high speed, the locomotive will be very much heavier than one designed especially for freight service having the same continuous tractive effort. The cost also will be much greater. An economical mechanical design for a locomotive which is thoroughly satisfactory for freight service will not be at all suitable for the high-speed passenger service.

TRANSMISSION

While many types of transmission are in successful operation, none is above criticism from some point of view. Gearless motors in which the armatures are carried dead on the axle while having the simplest transmission of all are destructive to roadbed when operated at high speeds. The mounting of the motor on a quill driving the wheels through springs is also objectionable from some standpoints, but it is open to less objection because its weight is all spring supported against both vertical and lateral shocks. There is a definite, though somewhat restricted field where the gearless concentric motor is most successful. High speed is essential to allow a rate of revolution sufficient to secure an economical power output per unit weight of motor. The gearless concentric motor for slow-speed operation cannot compete with the geared motor, as the weight and cost will be prohibitive. The power demanded per axle must not be so great as to result in wheel overloads.

GEARS

In the present state of the art, gears can be designed which will perform satisfactorily in any class of railway service. There should be no hesitancy on the part of the locomotive designer in recommending gears for service where a reduction from the armature speed is desirable, as in low-speed locomotives.

An advantage of gearing the motor to a quill having large clearance around the axle, as in the New Haven geared freight locomotive, is that it enables the motor to be mounted rigidly on the truck, and directly above the axle, thus permitting the greatest economy of space by bringing the driving axles close together. It also raises the center of gravity of the spring-borne parts and brings the motor well above the dust and dirt of the roadbed. And as the motor projects through the floor into the cab, the commutator, brushes and oil boxes are rendered accessible at all times. It also facilitates the use of forced ventilation, which greatly increases the capacity of motors of the enclosed type. This type of transmission has been in use but a short time, but the performance thus far has been so satisfactory as to give promise of its success in a wide range of application. It is believed that on account of the extreme flexibility of the drive that the pitch line speed may be raised to a much higher value than has ever before been deemed possible. The flexibility effectually prevents the extreme shocks which are ordinarily received by the gear teeth of a high-speed locomotive when the gear is pressed directly on the axle.

The use of gearing which permits the armature to run at a higher speed of rotation than the driving axle places a limit on the speed of the locomotive. For economical designs it is not advisable to allow a maximum armature speed of more than 2 or 2.5 times the continuous rating speed. If a greater ratio than this is required, the armature speed must be reduced. The weight and cost of motor for a given continuous capacity will increase directly with this ratio.

With theoretically perfect gears a very high pitch line speed should be operative. In regular interurban mounting of motors heavy strains are imposed on gear teeth in high-speed operation by sudden vertical displacement of wheels due to track irregularities, with attendant acceleration or retardation of armature. In such applications a maximum pitch-line speed of 3500 ft. to 4000 ft. per minute is used. With complete spring support of motor and flexible connection to wheels, or with flexible gears, a higher speed will be permissible. There are insufficient data at hand to approximate the limit under these conditions. Even better results probably can be obtained by the use of helical gears which are now coming into use. The success of this type of gear, which is used for the Melville-McAlpin steam-turbine drive, indicates a sphere of usefulness for gears which has scarcely been touched.

Experience thus far indicates that a pressure of 1000 lb. per inch width of gear face is perfectly practicable for continuous rating of large gears. With special steel pinions and high-grade gears it is probably safe to exceed this figure. For short hauls pressures far above 1000 lb. per inch are now in daily successful operation. In the locomotives for the St. Clair Tunnel, for instance, the pressure is carried on a single gear having a 6-in. width of face. The normal loads at which the locomotive operates on the up-grade give a pressure of from 1500 lb. to 2000 lb. per inch width of face on the gears. With this pressure the pinions have a life of 40,000 miles to 50,000 miles, and none of the gears has yet worn out, although the locomotives have been in continuous operation for over two years. With twin gears there is a possibility of further increase in unit pressure as the absence of relative skewing of pinion and gear shafts produces a better application of the tooth load. Motors of 500-hp continuous rating are about as large as can be geared to a single axle.

SIDE RODS

The wish to get the good riding qualities of the high-speed steam locomotive, and at the same time to avoid the difficulties and limitations imposed by mounting the motor concentric with the axle, had led to the adoption of side rods for transmitting the power from the motor to the wheels. There is a very strong tendency in this direction both in Europe and in this country. This type permits the use of a single powerful motor to drive two axles. The motor is mounted in the cab instead of under it so that all parts are readily accessible and are thoroughly protected from the dust, dirt and water from the roadbed. The location of the heavy motor so high in the cab raises the center of gravity of the locomotive to height corresponding to that of high-speed steam locomotives. It is susceptible of perfect mechanical balance and gives a uniform tractive effort.

In case of a steam locomotive there are at least two independent sources of mechanical forces, viz., the cylinders. Each piston constitutes a "free end" of the transmission system. The distance from the center of cylinder to the center of main driver axle is not a hard and fast value.

In an electric locomotive with a single motor crank and rod connected to a countershaft there are no "free ends." Great accuracy of tram and parallelism of motor shaft and countershaft are essential, any error being accompanied by serious stresses in the transmission with associated low mechanical efficiency and high maintenance charge, especially for bearing brasses. The motor exerts a constant turning moment or torque throughout the entire revolution. This constant torque must be transmitted to the driving axle without modification except for the losses in bearings. At certain points in the cycle all the torque of the motors is transmitted through one crank; at certain other points it is transmitted through the opposite crank. At intermediate points it may or may not be transmitted through a single crank, as the interchange of work is different in different machines, being a composite function of journal and pin clearances together with bending and torsional deflections of all elements of the transmission and framing. All the driving effort is transmitted through four running pins in series before any useful work is performed. This results in considerable loss of mechanical efficiency. It may be noted that the use of knuckle pins would avoid one or possibly two of the running

pins mentioned. Knuckle pins have caused so much trouble from breakage that they will have to be modified considerably before they will be acceptable. The trouble seems to lie in the twisting of the rods due to uneven track.

The side-rod type of locomotive is at a disadvantage when compared with the high-speed geared type described, because of the fact that the mechanical parts of the locomotive and also the motor frames must necessarily be much heavier to withstand the reciprocating stresses imposed on them. They will also require much more careful work in assembling and will, therefore, be more expensive. On the other hand, it would seem that after the side-rod locomotive is once completed, the mechanical parts should be very cheap to maintain.

The Scotch yoke side-rod drive has been used to the greatest extent with the three-phase locomotives in Italy and has apparently given excellent results. The motors, being flexibly attached to the spring-borne parts, are not subject to severe cranking strains and can therefore be made light mechanically. The other parts also can be made considerably lighter because of the fact that no jack-shaft is required, and the cranking strains are taken directly on the armature shafts which are supported in bearings in the side frames. The design, however, sacrifices high center of gravity, and some alternate plan for securing easy riding qualities must be adopted. One which has been suggested utilizes a plan somewhat in line with that suggested for the gearless concentric motors; namely, having springs between the motor and side frames for cushioning lateral shocks. The mechanical efficiency of this type should be higher than that of the rod-connected design, because of the fact that the power is not transmitted through so many running pins. It has the objectionable feature of a sliding connection between the driving yoke and the pin on the middle driving wheel, but this apparently causes no trouble whatever. In fact, the locomotives as observed on the Valtellina Railway operate smoothly, and apparently with small friction loss. This may be ascribed in part to the fact that all bearings are kept flooded with oil. This type of drive will give probably a lighter locomotive than is possible with any other drive having motors operating at the same speed as the driving axles. It has thus far not met with favor in this country, but its merits will undoubtedly bring it into use for moderate speed work where gearless motors are desired.

Where slower speeds are desired than can be secured by the use of motors operating at the same speed as the axles it is sometimes more economical to use two motors geared to jackshafts and connected to the drivers by means of the "Scotch yoke" in the same way as just described. This scheme permits the use of large motors and gives much greater space for them than can be secured between the drive wheels where the motors are geared either to the axles or to quills surrounding the axles. The motor is mounted so that its center of gravity is high, and as it extends through the floor into the cab, the bearings and brushes are easily accessible. In this respect the motor has all of the advantages possessed by the rod-connected motor. Gears can be located outside of the driving wheel so that they can be replaced without dismantling the locomotive any further than required by the removal of the side rods. Locomotives involving this principle have been built in Europe, and a large one is now under construction for the Midi Railway in France.

In the three-phase locomotives now in use in the Simplon Tunnel the motors are located as close together at the middle of the locomotive as possible, and their crank pins are connected together by a frame. From pins on this frame on a line with the center of the axle rods are carried to the nearest driving wheels, and thence other rods connected to the axles of the outer drivers, there being four pairs of driving wheels. It is, of course, essential where side rods are used that all axles should remain substantially parallel, and in order to secure the radial motion of the wheels at the ends of the locomotives it is necessary to mount the wheels on quills which surround the axles and connect them together only at the middle point by a kind of universal joint. By these means the wheels are able to move in a radial direction, while the axles which drive them are kept parallel to the inside driving axles. This seems to be operating very satisfactorily, and with some modifications will probably meet other conditions where all the weight is carried on the drivers, and a rigid frame locomotive with flexible wheel base is required.

The possible combinations of locomotive framing, motors, and transmission between motors and drivers which have not been mentioned are almost limitless.

ECONOMY OF CAR OPERATION*

BY CYRIL J. HOPKINS.

The value of increasing the coasting time on a given run is well illustrated by the experience of the Philadelphia Rapid Transit Company on its subway and elevated division. As a result of installing coasting signs showing when to shut off the motors the energy consumption was reduced about one-third and the cost of brake shoes, which is one of the largest items of equipment maintenance, was reduced by almost the same amount. Recent tests made on the Atlantic City & Shore Railroad confirm this experience and also demonstrate the saving in current made possible by the use of anti-friction journal bearings which cut down the bearing resistance during acceleration and increase the permissible coasting time.

The interurban section of this road is 15.2 miles long, of which some 13½ miles are double track. Two series of tests were carried out, one making all, and the other only compulsory stops. The tests were carried out with two cars, exactly similar, except that one had ball bearings on the main journals, and the other had ordinary brass bearings. Ten complete trips were made first with the plain bearing car. Conditions of running were then imitated as nearly as possible with the ball bearing car. The cars used in these tests weigh 36 tons empty and carry 8 tons of passengers when crowded. One long stretch of about 4¾ miles between stops exists, while the other stretches of track between stops are nearly equal and can be averaged to 2,900 ft. in one case, and 5,490 ft. in the other.

For train resistance with ordinary brass bearings the Armstrong formula has been generally accepted. It is required to give a formula that will represent equally well the train resistance of a car or train with anti-friction bearings. Considering the Armstrong formula, the last term, referring to wind resistance, is independent of the type of bearing and, therefore, remains unchanged, while the first two terms, which represent track and bearing resistance (which have not so far been satisfactorily separated) will be decreased. One-third of the amount given by the Armstrong formula for the total of the first two terms has been found to be substantially accurate.

Acceleration curves for ball and plain bearing cars at first glance appear to have very little difference in the accelerations for the two types of cars, but during the first 20 seconds, in which a speed of 25 m.p.h. (a little more than half speed) is attained, the advantage of anti-friction bearings is less important than during the latter part of the acceleration period, which consumes the greater portion of the time. In this latter period the ball bearing car has an advantage of 25 to 100 per cent over the plain bearing car. The benefits to be derived from coasting from an energy point of view are quite marked. With a plain bearing car making a run of 2,900 ft. the least time in which the car covered the distance was 82 seconds, which admits of no coasting. Under such conditions the car consumes 110 watt-hours per ton-mile. If it is satisfactory to make this same run in 83 seconds, a 16-second coast is admissible, bringing down the energy consumption to 94 watt-hours per ton-mile or a saving of 17 per cent. If, again, it is satisfactory to make this run in 85

*Abstract of a paper read at the annual convention of the American Institute of Electrical Engineers, Jefferson, N. H., July 1, 1910.

seconds, 30 seconds coasting may be employed and a saving of 25 per cent attained in energy consumption.

It is often claimed that it is impossible to make the motormen carry out the coasting as desired. They should not be expected to do it unless they are instructed. As to whether this instruction is worth while or not is readily borne out by the above statement of savings in reference to the Philadelphia subway. This is also emphasized by the importance which the Interborough Rapid Transit Company of New York is attaching to it, by the employment of coasting registers on the cars.

Calculated runs with ball and plain bearing cars over a distance of 2,900 ft. in 83 seconds show that the increased coasting time of the ball bearing car is 11 seconds. This means that the controller is shut off that much earlier and, consequently, the motor losses, which are a high percentage of the motor output at high speed because of low current consumption, are reduced. The greater saving, however, results in the elimination of the bearing friction. The figures representing the elements of loss are given in the following table:

2900-FT. RUN IN 83 SECONDS. FOUR MOTORS GEAR RATIO 2,625. WEIGHT OF CAR 26.3 TONS

Losses in	Watt-hours. Plain bearings.	Ball bearings.	Saving per cent.
Starting resistance	200	190	5
Windage	165	165	0
Track and bearings	330	110	67
Braking	905	850	6
Motors	275	245	11
Total	1,875	1,560	17 or 0.57 kw-hr. per car mile

A comparative analysis of a longer run on the same railway is given below:

5490-FT. RUN IN 136 SECONDS. FOUR MOTORS. GEAR RATIO 2,625. WEIGHT OF CAR 36.3 TONS.

Losses in	Watt-hours. Plain bearings.	Ball bearings.	Saving per cent.
Starting resistance	170	165	3
Windage	380	375	1
Track and bearings	655	215	67
Braking	780	830	6
Motors	395	300	24
Total	2,380	1,885	21 or 0.48 kw-hr. per car mile.

It will be noted that the saving in watt-hours per car-mile in each case is about 0.5 kw-hour irrespective of the number of stops, but that in short runs the amount represents 17 per cent and in the long runs 21 per cent.

The following are the average results per trip over 15.2 miles, the same motorman being employed for comparative runs:

TRIPS WITHOUT PASSENGERS—20 STOPS—NORMAL RUNNING TIME

Car bearings	Time running with power on minutes.	Average speed in motion m.p.h.	Loss in rheostat kw-hr.	Loss in motors and gears kw-hr.	Loss in train resistance and brakes kw-hr.	Total kw-hr. for traction.
Plain	27.07	25.4	3.62	8.11	32.43	44.16
Ball	26.08	25.2	3.30	7.04	28.18	38.52
Difference	4%	1%	9%	13%	13%	13%
In favor of...	Ball	Plain	Ball	Ball	Ball	Ball

SECOND TEST—11 STOPS

Car bearings.	Time running with power on minutes.	Average speed in motion m.p.h.	Loss in rheostat kw-hr.	Loss in motors and gears kw-hr.	Loss in train resistance and brakes kw-hr.	Total kw-hr. for traction.
Plain	25.04	28.3	1.81	6.93	27.71	36.45
Ball	22.44	28.7	1.76	5.77	23.08	30.61
Difference	9%	1%	3%	17%	17%	16%
In favor of....	Ball	Ball	Ball	Ball	Ball	Bal.

It will be noted that, with the greater distance between stops, the saving as an absolute amount is about the same, but that as a percentage it is increased. The amount of time with the current on is 9 per cent less with a ball bearing car than with a plain bearing car, while the speed of the former is slightly in excess of that of the latter.

ANTI-FRICTION BEARINGS

Long rollers for anti-friction bearings are unsatisfactory mechanically where continuous service is required. However, if the rollers are made short, they will become bent less easily, but will still tend to wear taper. Balls will neither deform nor wear appreciably out of shape, with reasonable protection from grit. The ball bearings on the Atlantic City car and other railway equipment, including mining and street railway motors, that have been equipped with this type of ball bearing, have not shown any appreciable radial wear after nearly two years' service, have not had any repairs and, with the exception of mining motors, have been lubricated something less than twice a year.

With regard to hot bearings city railways on account of their relatively low speed are not troubled much, but interurban roads finds such occurrences more common. Even though the hot bearings may not always result in delays, still when they occur on motors they prevent satisfactory radiation, producing defective insulation, especially in field coils. In a recent series of tests made by a railway company, the average difference in temperature rise on field coils for motors with ball bearing armatures as compared with babbit bearing armatures was 6½ deg. Cent. or 20 per cent. These tests extended over nine test days with each type of car and continued for about eight consecutive hours each day. The ball bearings on the main journals of the Atlantic City car will operate continuously all day without a rise in temperature, due to heat generated within themselves, sufficient to be detected by the hand.

The following statements of cost illustrate in a general way the commercial situation, for interurban cars of the Atlantic City type.

From the tests it is evident that at least 0.5 kw-hour per car-mile can be saved, hence, with an annual car-mileage of 60,000 (or 200 miles per day and nine weeks layoff per year) and assuming 1 cent per kw-hour at the power house with 88 per cent efficiency of trolley line, this amounts to $340. The total cost of a set of bearings and boxes per car is $688, as against $120 for plain bearings. The interest on the difference in cost and an allowance for depreciation amounts to $150. The net saving per year, therefore, is $190 in favor of ball bearings.

MINIMUM HEADWAY FOR CARS IN CONGESTED STREETS

In a paper read at the annual convention of the American Institute of Electrical Engineers, Jefferson, N. H., July 1, 1910, R. W. Harris, field electrical inspector of the Wisconsin Railroad Commission, described the methods used in determining the adequacy of the service given by the Milwaukee Electric Railway & Light Company during the latter part of 1908. Some particulars of this investigation were included as an appendix to the annual report of the Wisconsin Railroad Commission for 1909 and were published in abstract in the Electric Railway Journal for April 9, 1910, page 664.

The first step of the investigation was to compile "car demand" curves for each of the lines, showing the number of passengers carried during different periods of the day and on different sections of each line. These "car demand" curves also showed the comfortable load for each car. The excess number of passengers carried over and above the comfortable load determined the amount of additional equipment required to be operated in order to give adequate and satisfactory service.

Following this part of the investigation a study was made of the schedules on each line to determine what, if any, additional equipment could be safely operated during the rush

hours in the congested districts. This led to a study of car delays. The minimum time spacing of cars is the determining factor which fixes the full-load capacity of any section of track. In determining the safe minimum headway from observed data, the following basic elements were considered separately:

(A) The minimum safe practicable time spacing of cars when in continual motion, unaffected by any delay.

(B) The average delay of cars due to causes arising from other cars operated over the same or intersecting tracks.

(C) The average delay due to causes having their origin within the car under consideration—that is, delays due to passengers boarding and alighting.

A calculation for the safe headway between cars would require an allowance to be made, first for the space covered in one section at full speed to allow the train's crew to act; second, for the distance required to stop the car from an assumed or observed maximum speed with an assumed negative acceleration of 1½ miles per second; third, for a clear space of 15 ft. between cars when stopped. As an example, a headway of 8 3/10 seconds would be calculated from the following observed data: Length of car, 41 ft.; safe space between cars with stops, 15 ft.; observed speed, 12.27 ft. per second; speed in miles per hour, 8.4; distance car travels after braking, 34.22 ft.; safe minimum spacing, 102.49 ft.; number of cars passing a given point per hour, 433. The safe minimum spacing in feet is the sum of the length of the car, the space between cars when stopped, the observed speed in feet per second, and the distance traveled after braking.

The delays specified under (B) include for a typical intersection the following:

(1) Car ahead going in the same direction upon approaching the intersection, but taking a curve.

(2) A car taking the curve in nearest quadrant, but resulting in going in the opposite direction.

(3) One car crossing at right angles.

(4) Two cars crossing at right angles, but going in opposite directions.

(5) Regular service stops.

(6) Unusual vehicle or pedestrian traffic.

(7) Delay due to hesitancy of motorman and signalman.

(8) Delay due to hesitancy of cars approaching switches before taking the curves.

From observed data at a typical intersection 34 per cent of cars are delayed from cause 1; 34 per cent are delayed due to cause 2; 187 per cent due to cause 3, this percentage being used as a measure of the tendency to interruption; 10 per cent are delayed due to cause 4; 100 per cent are delayed due to cause 5; 10 per cent are delayed due to cause 6; 50 per cent due to cause 7, and 75 per cent due to cause 8. Any car may be delayed approximately two seconds for other reasons. From a large number of observations the composite delay was calculated by weighted averages and found to be 10 seconds. The minimum safe practicable headway, therefore, would be the safe headway for cars in continual motion unaffected by delays, plus the time due to delays, or 18.3 seconds. Data was obtained from other cities showing the operating speeds and average delays, and it was found that the operating speed in Milwaukee is somewhat faster than that in other cities. A minimum safe practicable headway of 20 seconds was, therefore, selected in studying the problem involved in routing cars through the congested districts.

The delays due to passengers boarding and alighting were shown for various cities by a curve published in the abstract of the report of the commission printed in the ELECTRIC RAILWAY JOURNAL for April 9, 1910, page 665.

The committee on construction of schedules and timetables of the American Street & Interurban Railway Transportation & Traffic Association has sent out, through Secretary Donecker's office, data sheet No. 58 asking for information on the methods used for the preparation of schedules and timetables for different times of the day and different days of the week. The questions on interurban work are separate.

DISCUSSION OF RAILWAY PAPERS BY AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The annual meeting of the American Institute of Electrical Engineers was held at Jefferson, N. H., June 28 to July 1. At the session of Friday morning four papers on railway subjects were presented and discussed. Abstracts of these papers are printed elsewhere in this issue.

ELECTRIC LOCOMOTIVE DESIGN

A paper on "Electric Locomotive Design," by N. W. Storer and G. M. Eaton (see page 76) was first read. In opening the discussion on the paper, A. F. Batchelder, General Electric Company, said he believed that no bad effect on the track was produced by a moderate amount of dead weight on the axles provided the rotating parts were balanced. The height of the center of gravity of the locomotive was important, but the distance between side springs was equally important. It was desirable to get the springs as close together as possible. Concentrating the weight longitudinally near the center of the locomotive was good practice, but it was also necessary to introduce a dampening effect on the springs to prevent cumulative lateral oscillation. He exhibited a drawing of a new design of heavy electric locomotive consisting of two units, each having a four-wheel guiding truck and two drivers, as is in the Pennsylvania tunnel locomotives. The locomotive had inside frames and each driving axle was connected to a separate motor with rods and gears on each side.

Frank J. Sprague pointed out that the track and the locomotives are closely tied together and neither can be sacrificed for the other. He did not think that a high center of gravity was as important as the authors of the paper had claimed. What was vital was that every wheel should be free to move slightly either vertically or horizontally without affecting the mass of the entire locomotive. Nosing was due, in his opinion, largely to the coning of the wheels which caused them to tend to move first to one side and then to the other. The higher the speed the freer is this movement, and the blows delivered to the side of the rail are correspondingly more severe. He explained in this way the nosing tendency of the first New York Central locomotives when running on tangent track. When the side motion of the guiding trucks was dampened the nosing was largely stopped. He did not believe that the Woodlawn accident was caused directly or indirectly by the effect of the low center of gravity of the locomotive. The use of four-wheel guiding trucks and lateral motion springs on the driving axle boxes effected a marked improvement in the riding qualities of these locomotives. Mr. Sprague referred to tests of a double-truck locomotive on the New York Central which had a decided nosing tendency when run with the two trucks not connected together. When the two trucks were connected with a link the nosing tendency disappeared. The speaker believed that a locomotive with a symmetrical wheelbase was superior to one with an unsymmetrical wheelbase. Under certain conditions it might be very desirable to build locomotives which could be used interchangeably in freight or passenger service. On most mountain grade divisions the use of pusher engines which can be picked up or dropped off afford the most economical method of operation. These engines should be equally suitable for assisting freight and passenger trains up the grade.

A. H. Armstrong, General Electric Company, also thought that there were many cases in which interchangeable freight and passenger locomotives would be very desirable.

G. M. Eaton, in closing the discussion, spoke favorably of the use of plate frames for locomotives which provide some degree of flexibility. Referring to the speed tests of locomotives on the West Jersey & Sea Shore Railroad the speaker said that electric locomotives Nos. 10,001 and 10,002, which were of the coupled double-truck type with geared and gearless motors, respectively, proved very destructive to the track at speeds above 60 m.p.h. The side-rod locomotive No. 10,003, which had a high center of gravity, rode easily at all speeds up to the maximum of nearly 100 m.p.h.

COASTING CLOCK TESTS

H. St. Clair Putnam presented his paper on "Coasting Clock Tests" on the Manhattan Elevated Railway (see page 72).

A. H. Armstrong asked if any change in the substation peak loads had been observed as a result of the rapid acceleration obtained by the motormen in striving for good records. It was possible to carry rapid acceleration so far that an unduly large investment in substation capacity was necessary. The best method of obtaining rapid acceleration was to increase the speed quickly while running in the series position and thus reducing the rate of acceleration somewhat when the motor connections are shifted to parallel. This keeps down the peak loads.

N. W. Storer thought the coasting clock was a better device for saving current than the wattmeter.

L. B. Stillwell referred to the statement in Mr. Putnam's paper that the increase in coasting time on the Second Avenue division from 12 per cent to 35 per cent resulted in a saving in power consumption of 24 per cent. He said that the cost of power for this division, including overhead charges, was about $4,000 a day, and that the saving of 24 per cent represented nearly $1,000 a day. Answering Mr. Armstrong, he said that the use of current clocks had resulted only in increasing the coasting time up to the economical point which the engineers had used in designing the electrical equipment.

Frank J. Sprague said the coasting clock apparently had worked as great an improvement in braking as the use of automatic relays had improved acceleration. It removed the motorman's last chance to waste power.

C. J. Hopkins asked if any inducements were offered to the train and platform guards to shorten the station stops and thus permit of longer coasting periods between stations for the same running time. N. W. Storer said it was perfectly feasible to arrange the automatic control as Mr. Armstrong suggested so as to accelerate at a high rate in the series position and at a lower rate in the parallel position.

Mr. Putnam in closing the discussion said that the mechanism and connections of the current clocks had been worked out very carefully so as to prevent any tampering. Each motor car is equipped and as there are usually three motor cars in a train, each clock would have to be manipulated separately to obtain a false record. The point raised by Mr. Armstrong regarding excessive peak loads was not serious on a system with as dense traffic as is handled on the Manhattan elevated. The great saving obtained with these clocks was due not so much to improvement in acceleration, but in manipulation of the trains when running close together. The ordinary motorman would run up close behind a preceding train, stop, and then pull up again when the preceding train moved ahead. The motorman who is trying to make a good coasting record, however, will drift cautiously up to a preceding train and if the latter pulls out of the station before the following train has stopped the motorman of the following train will drift into the station without using power. Nothing is gained by running up too close to a preceding train. Referring to the matter of inducements to train guards to shorten station stops, Mr. Putnam said the motormen, who were held responsible for their own coasting records, were quick to report a guard who caused any delay which would shorten the possible coasting time. Station stops have been reduced materially on this account as the train men do not like to be reported. Failures of the clocks have been few, and when a failure does occur the faulty record is thrown out.

ECONOMY IN CAR OPERATION

C. J. Hopkins presented a paper entitled "Economy in Car Operation," which is abstracted on page 79 of this issue.

A. H. Armstrong asked why advantage had not been taken of the opportunity to use a lower gear ratio on the car equipped with ball bearings which could have been done owing to the reduction in friction. N. W. Storer thought the author of the paper went too far in claiming for ball bearings all the advantages which accrued from an increase in the coasting time. The motors could be pushed a little harder to give the same acceleration with plain bearings as with ball bearings and the only actual saving was that due to the difference in friction. By eliminating all bearing and track friction the gain would not exceed 20 watt-hours per mile.

Frank J. Sprague predicted the future use of ball bearings on railway motor armatures. He thought the saving to be effected there was greater than in the journal bearings.

Mr. Putnam said that the only proper credit to be given to ball or roller bearings was the difference in the number of foot-pounds of energy required to move the car from one point to another. Any other saving was due to a change in the speed characteristics of the motors. The effect of using roller bearings in the tests cited by Mr. Hopkins was to increase the maximum speed from 43.5 m.p.h. to 47 m.p.h., and the obvious thing to do in such a case would be to reduce the gear ratio. The method of applying Armstrong's formula for train resistance as used by Mr. Hopkins, he believed, was erroneous, and the reduction in bearing resistance claimed for ball bearing he thought was excessive. The maximum rolling friction found by test on the New York subway and elevated lines was less than 5 lb. per ton, and the speaker did not think that the first term of the Armstrong formula should be reduced by as much as two-thirds.

A paper by R. W. Harris on "A Method of Determining the Adequacy of an Electric Railway System" was read but not discussed. This paper is abstracted on page 80 of this issue.

PITTSBURGH SUBWAY REPORT

Under date of June 29 B. J. Arnold submitted to Mayor Magee, of Pittsburgh, a report on a proposed subway line in that city. The report first states that topographically the city is not well adapted for elevated railways, but that a subway between the downtown business district and certain centers in the outlying districts appears to be a natural development and eventually will be a necessity. An abstract of the principal parts of the report follows:

FIRST COST AND OPERATING EXPENSES

The first cost of a double-track subway, fully equipped, may be estimated as between $1,000,000 and $2,000,000 per mile of single track, depending upon the physical difficulties, size, elaborateness of design, number of stations, amount of rolling stock and other equipment, value of real estate necessary for stations, terminals, shops, yards, etc. A subway system for Pittsburgh should hardly be undertaken unless an expenditure of at least $30,000,000 is contemplated, half of this amount, at least, to be spent for the sections first built.

The ratio between operating expenses and gross earnings under subway conditions varies between 40 per cent and 60 per cent, with a fair average at 50 per cent. The average operating expense of a surface system is from 60 per cent to 70 per cent of passenger earnings, and it is owing to the fact that subways can be operated at a relatively less percentage that justifies the larger investment in situations where the density of traffic is great.

EARNINGS

The annual earnings from operation should amount to not less than 10 per cent of the first cost, and seldom it will amount to more than 15 per cent, for before reaching this latter figure there would no doubt arise demands for extensions. These figures indicate on what narrow margins enterprises of this character must be financed. Under Pittsburgh conditions I believe that an average annual earnings from passengers equal to at least 12 per cent of the first cost of the system will be necessary to make a subway practicable.

If the first section of the subway must earn an amount equal to $12 per cent on $15,000, or $1,800,000 per year, when will it be possible to build it?

The earnings per capita of the surface system is now about $10 as an average, but certain residence sections of the city run as high as $28 per unit of "sleeping population" of the district.

Earnings per capita increase at a rate not less than the rate

of increase in population, and often at a faster rate, depending on the riding habit of the community. Therefore, at $10 per capita, the subway must serve 180,000 people to earn $1,800,000 yearly, or at $20 per capita only one-half this number, or 90,000 people would be required. A conservative estimate would be that if a subway can be designed to serve 150,000 people contributing $12 each per annum to the subway in addition to their use of the surface system, then an initial investment of $15,000,000 would be justified or at the rate of $100 per person served.

DENSITY OF POPULATION

At present the maximum density of population in Pittsburgh over any considerable area is about 100 persons per acre. In New York the density per acre for the lower "East Side" is about 700 per acre, and in Harlem, which is the best contributing district for the New York subway, the density is 150 per acre, which is the same as the average for the entire Island of Manhattan. At 100 per acre, 150,000 people would occupy 1500 acres, or 2.35 sq. miles, while at 50 per acre the district required for 150,000 people would be twice as much, or 4.7 sq. miles. It is very probable that, with the opportunities which Pittsburgh has of spreading out, that there will not be sufficient increase in land values to justify whole blocks of high apartment buildings such as are found in New York City. But there will be, no doubt, considerable development in the line of apartment dwellings, which will raise the present average density of population in many sections, although it will not be safe to count on large contiguous residence areas where the average density will reach as high as 100 per acre. This would indicate that the first section of the subway would be designed to serve an area of about 4 sq. miles.

COMBINED SURFACE AND SUBWAY SYSTEM

To reach the amount of territory to secure a patronage which will justify a subway it will be wise to count on a combined system using the subway as a main trunk line and the surface railway as a means of collecting and distributing the passengers over a wide area. Furthermore, in order to use the tubes to best advantage, they should be located and designed so as to accommodate suburban trains coming into the city over the various lines of the present railroads, which eventually may be electrified. With these two auxiliary systems contributing to the earnings of the subway, it would be unnecessary to be so dependent on the earnings of the territory directly contiguous to the main trunk line.

However, to secure this "transfer" and "through" business it would be necessary to design a subway for real rapid transit by eliminating the stops in the short-haul territory just outside the business center of the city and to operate trains instead of single car units.

FINANCIAL CONSIDERATIONS

Any public transportation utility to be permanently successful should be able to carry the following financial burdens:

First.—Operating expense, including taxes, damages, insurance and maintenance which will vary from 40 per cent to 60 per cent of the passenger income, depending upon the volume of traffic.

Second.—Depreciation fund, which will vary from 3 per cent to 5 per cent annually upon the cost of equipment only.

Third.—Amortization fund, which at 1 per cent per year on cost of construction (compound at 2.5 per cent) will retire the investment in structure in 50 years, or at ½ per cent per year would amount to the first cost of construction in 75 years.

Fourth.—Contingent reserve fund to take care of extraordinary accidents and other unforeseen contingencies, which should accumulate and be kept invested until it reaches about 5 per cent of the total cost.

Fifth.—Interest on cost, which may vary from a maximum of 8 per cent with private capital down to 4 per cent with municipal credit.

Sixth.—Discount fund, which should offset the discount on bonds or other similar indebtedness in about 20 years.

Seventh.—Surplus profits, which in case of private ownership should be divided with the city or used to build extensions.

RETURN ON INVESTMENT IN SUBWAY

The earnings and net returns will depend on the following:

(1) The density of the population to be served and upon the rides per capita.

(2) Equitable arrangement for exchange of transfers between the subway and the collecting and distributing surface system.

(3) Use of subway as a downtown terminal by the electrified branches of present steam lines.

In my opinion a subway in Pittsburgh will pay eventually, but there will be a loss during the first years of operation, and particularly if it is built too soon or upon too large a scale. To insure the stability of the enterprise, this deficit must be offset by the profits made during subsequent years and therefore in order that the turning point when earnings exceed operating expenses plus annual fixed charges be not too long deferred, the subway should not be constructed until definite arrangements have been made with existing transportation systems for the joint use of the subway to the mutual advantage of the companies and the traveling public.

The operating expenses may be controlled to a certain extent as the service rendered may be made to suit within limits the traffic available, but the annual fixed charges will be the result of preliminary arrangements which cannot be reduced without financial loss to the original investors.

For instance, the first cost will depend upon:

(a) The actual cash cost of the property.

(b) The profit to be allowed the contractor.

(c) The interest paid during construction.

(d) The discount for underwriting funded debt.

(e) The profit to be allowed the promoter.

And the annual fixed charges, after paying operating expenses (including maintenance, taxes, damages and insurance) will depend on what is allowed for:

(a) Interest on funded debt.

(b) Depreciation.

(c) Sinking fund for retiring cost of construction.

(d) Reserve fund for contingencies.

(e) Discount fund to offset discount on bonds.

(f) Dividends to reward enterprise or to cover a fair return on the investment.

(g) Percentage, if any, to be paid the city for its share of gross or net earnings.

PROBLEMS REQUIRING INVESTIGATION

To determine more definitely the prospects of building a subway in advance of actual needs, so that it may become an important factor in influencing the extent and character of the growth of the city and district, it will be desirable to proceed along the following lines of inquiry:

(1) Ascertain the "best terms" which private capital will offer or accept for building, equipping and operating the subway and giving the city the right to purchase.

(2) Secure by legislation the right for the city to issue bonds, of a type self-supporting and independent of the debt limit, so that money for purchasing or constructing a subway and possibly for equipping it also, can be secured by means of the city's credit, and thus reduce to a minimum the fixed charge for interest.

(3) Determine what the present street surface railway company will do in regard to interchanging transfers with the subway.

(4) Determine what the steam railroad companies will do in regard to electrification of their suburban tracks and renting the use of the subway as a downtown terminal or for a through-passenger connection for suburban trains.

(5) Determine by comparing the present census with others, the rate of growth of the sections which may be affected by rapid transit development.

(6) Ascertain the probable increase in value of the real estate in the districts to be served in order to determine whether or not this increase in value of land will justify the building of apartment houses in sufficient numbers to result in a density favorable to subway operation.

UNIT COSTS OF ELECTRIC RAILWAYS

In a paper to be read at the joint meeting of the American Society of Mechanical Engineers and the British Institute of Mechanical Engineers in London, July 29, 1910, W. B. Potter, of the General Electric Company, gives some interesting estimates of cost of equipping steam railways and interurban railways with electric apparatus. Table I, reproduced herewith, relates to trunk line electrification. In discussing the relative merits of the four systems Mr. Potter says in part:

"Direct-current at either 600 volts or higher may be considered the most economical for city and interurban service, and for the electrification of steam railways where the density of traffic is sufficient to require a relatively large investment for rolling stock, as compared with that required for the secondary distribution system and the substation apparatus. Single-phase and three-phase rolling stock equipments are applicable only to exceptional conditions. The reason for this is the greater first cost of such equipments. This is especially true when comparing single-phase with direct-current. The type of equipment used on the rolling stock may well be a more important factor in the economy of investment and operation than the scheme of power distribution.

TABLE 1. COST OF TRUNK LINE EQUIPMENT

	600 v. D. C.	1200 v. D. C.	11,000 v. 1-Phase	11,000 v. 3-Phase
SUB-STATIONS				
First cost per kw, complete	$26	$28	$11	$12
Comparison of installed kw, %	200-250	100-125	100	100-125
Load factor, machines in service, %	20-40	35-70	40-80	30-60
Average efficiency, %	78-88	87-92	97-98	97-98
Yearly operation and maintenance, each station	$5000	$5000	$2500	$2500
CONTACT CONDUCTORS*	Third Rail		Overhead	
First cost, per mile	$5000 to $7000	$5500 to $7500	$3500 to $7000	$4500 to $8000
Efficiency, %	88-92	90-96	93-97	93-97
Maintenance per mile per year	$75-$125	$100-$150	$100-$200	$125-$250
ROLLING STOCK†	600 v. D. C.	1200 v. D. C.	11,000 v. 1-Phase	11,000 v. 3-Phase
Locomotives				
First cost, each	$44,000	$47,500	$64,000	$58,000
Weight, tons (2000 lb.)	125	125	160	160
Average efficiency, locomotive wheels of trolley, %	85	85	79	81
Maintenance per locomotive per mile, cents	4	4	8	5
Motor Cars (Complete)				
First cost, each	$12,000	$13,500	$20,000	.....
Weight, tons (2000 lb.)	43	44	54	.....
Average efficiency, wheels to Trolley	82	81	73	.....
Maintenance per car mile, cents	2	2.2	3.5	.....

*Variation in cost of third rail due to different weights of rail which may be required. Variation in cost of overhead due to variation in the class of construction, such as wooden poles or with steel bridges.

†Other weights of locomotives will cost more or less about in proportion to their weights. With gearless direct-current locomotives, the average efficiency of locomotive wheels to trolley is approximately 88 per cent.

"Under the conditions which exist in America, direct-current and single-phase are applicable to either level or grade work; while three-phase will probably be limited to the latter where its regenerative feature of returning energy to the line may be of value. The relative economy of the different systems of electrification is dependent on the density of traffic and the character of power available, rather than on the length of the railway. In cases where purchased power is used, or is depended on as a reserve, the frequency of the current supplied by the power company will have a bearing on the cost of substations, and will thus affect the choice of the system. For direct-current operation, rotary apparatus is used for converting the alternating into direct current, and the frequency of the supply is therefore relatively unimportant. For single-phase operation under the usual conditions, a frequency of not more than 15 cycles is desirable; and to provide this frequency, rotary frequency-changers are as necessary as are rotary converters in the case of direct current, since the frequency of existing power companies ranges from 25 to 60 cycles. With power supplied at the proper frequency for single-phase operation, permitting the use of static transformers and dispensing with frequency changers, the amount of energy required for a given trunk line service is in many cases nearly the same as for direct current, the greater weight of the equipped rolling stock, and the lower efficiency of the single-phase equipments, offsetting the rotary converters and trolley-line or third-rail losses of the direct current."

"In the selection of the electrical system best adapted to a particular set of conditions there are three items to be considered: (*a*) substations, (*b*) contact conductors, (*c*) rolling stock. A comparison of these items determines the relative economic values of the systems."

Mr. Potter gives the following outline of the effect of differences in the physical characteristics of the road and the operating requirements:

"From a level country to a limiting grade of 1 or 1½ per cent there will be little difference in the relative values of the systems. With steeper grades the conditions will be more favorable for alternating current.

"Heavy individual train units favor the alternating-current system with the exception of the locomotives; light trains or multiple-unit operation favor the direct-current system.

"Infrequent service with a relatively small number of locomotives favors the alternating-current, frequent service the direct-current. With increase in number of trains, the direct-current systems gain relatively faster than the alternating-current in economy of operation, due to relatively decreased substation operation, increased substation efficiency, and lower cost of equipment maintenance. It is therefore well to consider what the ultimate traffic density may be and select the system best suited to meet these requirements.

"Variations in the distance between stops and schedule required will not affect the relative value of systems unless extreme requirements, such as high schedule speed with short runs, make the use of direct current imperative.

"For a similar character of service throughout, the railroad may be of any length without affecting the relative desirability of the various systems. What is suitable for the first 50 miles will be equally suitable for any extension."

In the author's opinion the single-phase system, by reason of the apparent simplicity of its elements and the utilization of higher potential for the contact conductor than is possible with direct current, is admittedly very attractive. There is the other side of the question, that it is impossible to build a single-phase commutating motor comparable in first cost and maintenance with a direct-current motor. Comparative results obtained up to the present time are in favor of direct current.

Referring to the establishment of a standard system Mr. Potter says: "Desirable as would be a standard system for all classes of service, we cannot hope to establish such a standard should it impose an additional expense without adequate return. A summing up of all the elements of each electrical system will generally lead to a definite showing of which system is most desirable to meet specific conditions. For trunk line service a higher potential than 600 volts will unquestionably be used; 1200 volts direct-current will prove economical in some cases, but a still higher voltage is required to provide economically for the heavier intermittent service. Whether this potential will be 1800 or 2400 volts direct current or 11,000 volts alternating current cannot be settled arbitrarily."

INTERURBAN RAILWAYS

Mr. Potter discusses the interurban railway situation in the United States with regard to the various available schemes of electrification. These are, 600-volt direct current, 1200-volt direct-current, and single-phase, the three-phase being debarred on account of the complications of the necessary double overhead-distribution system. He says:

"The application of single-phase to new projects has been practically abandoned, there having been but one or two new installations in the last three years. This arrested development of a system which for a short time held forth considerable promise has been brought about by a general recognition of its limitations which experience has shown to be:

"(a) Excessive weight of rolling stock."

"(b) Excessive cost of rolling stock."

"(c) High cost of equipment maintenance."

"(d) Increased power consumption."

"(e) Rapid depreciation of motor."

"(f) Rapid depreciation of car bodies and trucks."

"(g) Increased cost of maintaining track and roadway."

"Moreover it is recognized that any interurban road in the United States must be capable of operating over existing city tracks from 600-volt direct-current trolley, a condition which hampers the single-phase system on account of increased complications in the control system.

TABLE II. GENERAL DATA FOR CARS

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Number of cars	15	15	18
Seating capacity, passengers	60	60	60
Distance between stops, miles	3	3	3
Schedule speed, miles per hour	33	33	33
Maximum speed, miles per hour	48	48	55
Weight each car, tons (2000 lb.)	35	36	43
Car miles per day	3000	3000	3000
Miles per car in service per day	300	300	300
Miles per car per day, average*	200	200	166
Estimated maintenance per car mile, cents:			
a Electrical	0.70	0.77	1.50
b Mechanical	1.00	1.00	1.25
Total car barn expense	1.70	1.77	2.75
Amperes starting car	520	280	75
Amperes running car	174	94	24
Kilowatt hours per car mile at car	2.8	2.88	3.78
Cost each car complete	$10,000	$11,500	$17,000

*On 12 American single-phase interurban roads the average miles per day called for on the published time tables, divided by the number of cars owned, is 138; on four 1200-volt roads which have been operating over a year this number is 237, the larger number of alternating-current cars being required on account of the fact that a greater number are necessarily held in the barn for inspection and maintenance purposes. This explains why in the table above 18 alternating-current cars are assumed and 15 direct-current cars.

TABLE III. SUBSTATIONS

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Number of substations	9	4	2
Estimated momentary demand:			
Cars starting	1	1	2
Cars running	1	1	0
Peak load, kilowatts	416	448	670
Average load, each substation, kilowatts	52	120	275
Size each unit, kilowatts	300	300	300
Number of units	2	2	3
Load factor (machines in service)	0.17	0.40	0.46
Average efficiency	0.76	0.87	0.96
Cost each substation complete	$24,000	$26,400	$10,000

TABLE IV. FEEDER COPPER REQUIREMENTS.

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Maximum momentary demand midway between substations:			
Cars starting	1	1	2
Cars running	0	1	0
Amperes	520	374	150
Distance between substations	11.8	28	66.6
Equivalent stub-end feed	2.9	7	16.6
Feeder required addition to 4/0 trolley	4/0	1/0	none
Cost overhead construction per mile, including both trolley and feeder	$2,300	$2,100	$1,900

Bonding taken as $400 per mile of track.

Transmission line taken in each case at $840 per mile of track and assumed to run entire length of right of way.

Power house: No power house is included, but it is assumed that power is purchased at the power station bus at one cent per kw-hr. and fed at any convenient point into the transmission line.

"To show clearly the relative merits of the systems an analysis is made of an interurban railroad 100 miles long with cars operated in each direction every hour. This condition represents practically the minimum car requirements in the United States, and is therefore favorable to the single-phase. Any increase in traffic density will be relatively more favorable to the direct-current system on account of the lower first cost of cars, lower car maintenance and relatively lower cost of substation operation." The general data required are approximated in Tables II to VII on this page.

Commenting on these data Mr. Potter says: "There will be an additional cost of operation and maintenance with the single-phase system for the items of track and roadway, due to additional weight of cars, car shop expenses in providing greater facilities for shop inspection and repairs, and greater skill in superintendence of equipment. In a number of instances this has been found to amount to several cents per car-mile. A conservative estimate would require at least 1 cent per car-mile to be added for these items.

"The comparison in Table VII brings out the fact that even for conditions selected as favorable to the single-phase system, the 600-volt direct-current system is the more economical considering operation, maintenance and fixed charges. An examination of the elements which enter into the first cost and operation of a system will show at once that as the density of traffic increases there is a rapid gain in the relative advantage of the direct-current over the single-phase system."

TABLE V. POWER CONSUMPTION.

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Total kilowatt-hours per day at cars	8400	8650	11,400
Efficiency, secondary distribution	0.90	0.90	0.94
Substations	0.76	0.87	0.96
Transmission line and power house step-up transformers	0.94	0.94	0.94
Combined efficiency	0.64	0.74	0.85
Kilowatt-hours per day at power house	13,100	11,700	13,400

TABLE VI. SUMMARY OF COSTS

First Costs

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Transmission	$84,000	$84,000	$84,000
Substations	216 000	106,000	20,000
Secondary distribution	230,000	210,000	190,000
Bonding	40,000	40,000	40,000
Cars	150,000	172,500	360,000
Total	$720,000	$612,500	$694 000

Annual Fixed Charges

Depreciation	Life, years	Annuity 5%	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Transmission	20	30.34	$2,500	$2,500	$2,500
Substations	20	30.34	6,500	3,200	600
Secondary distribution	15	46.34	10,600	9 700	8,800
Bonding	10	79.50	3,200	3,200	3,200
Cars (A. C.)	12	62.83	.....	.....	22,600
Cars (D. C.)	15	46.34	6,900	8,000	.....
Total depreciation			$29,700	$26,600	$37,700

Interest and Taxes

Interest 5%, taxes 1.5% of cost of electrical material	$46,000	$39,800	$45,000

Insurance

1.5% of substation and car costs	$5,500	$4,200	$5,700
Total fixed charges	$81,200	$70,600	$88,400

Annual Operation and Maintenance

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
Transmission	$3,500	$3,500	$3,500
Substations	17,000	7,600	500
Secondary distribution, including bonds	9.000	9,000	10,000
Cars	18,500	19,500	30,100
Power at one cent per kw-hr.	47,800	42,700	49,000
Additional cost maintenance of track and roadway, shops and supervision, due to heavier cars and more expert supervision required for the single-phase	.....	.....	10 900
Total	$95,800	$82,300	$104,000

TABLE VII. COMPARISON OF COST OF SYSTEMS.

	600 v. D. C.	1200 v. D. C.	6600 v. A. C.
1 First cost	$710,000	$612,500	$694,000
2 Fixed charges	81,200	70,600	88,400
3 Operation and maintenance	95,800	82,300	104 000
4 Annual cost (Item 2 plus Item 3)	$176,000	$152,900	$192,400
Based on 1,095,000 car miles per year, additional annual charge per car mile above the cost for 1200 volts, in cents	2.1	0	3.6

In conclusion the author says that the saving effected by the 1200-volt direct-current system is so marked that a great increase in the adoption of this potential for this class of interurban railroading may be anticipated. On the other hand, it will not be surprising if the single-phase interurban system is entirely discarded in America, unless some improvement is made in the art and a more economical equipment made available.

ENGLISH TRAMWAY STATISTICS FOR COMPARATIVE WEEKS IN JUNE 1909 AND 1910.

The Tramway and Railway World states that the official tramway traffic returns of 64 of the principal undertakings of the United Kingdom for the week ending June 4, 1910, amounted to £199,330, or £18,665 less than for the corresponding week last year, while the track mileage was 2462, or 124 more than for the corresponding week. The receipts were at the rate of £80 19s. 3d. per track mile, a decrease of £12 5s. 6d. per mile as compared with last year. The receipts from the London County Council and Liverpool Corporation tramways included in the above return are for the preceding week, as these two corporations issue their returns later.

SUMMER CONVENTION OF WISCONSIN ELECTRICAL ASSOCIATION

While the attendance was not large, and extremely warm weather was encountered, the summer convention of the Wisconsin Electrical Association at Oshkosh, Wis., on June 28 and 29, well repaid those who attended, owing to the practical nature of the discussions. There was no formal program and no papers were prepared in advance. Two sessions were held, and the principal subject for discussion was rates, both for electric railway and electric service plants. Some other matters received attention, however. A fair-sized delegation of supply men was in attendance, but there were no exhibits. The meetings were held at the handsome house of the Oshkosh Yacht Club, fronting the broad expanse of Lake Winnebago, and the Wisconsin Electric Railway Company placed special cars at the disposal of the visitors to transport them between the hotel and the place of meeting. The president of the association, Clement C. Smith, of Milwaukee, was unable to be present owing to illness, and Irving P. Lord, of Waupaca, vice-president, occupied the chair. An account of the discussions on railway matters follows:

THE ELECTRIC RAILWAY RATE SITUATION

The first speaker was C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company. He referred to the effort of the city of Milwaukee to compel the company to carry people on the local street railway system for 3 cents each. At present six tickets are sold for 25 cents. The question has been argued exhaustively, and it now rests with the Wisconsin Railroad Commission to decide the matter on the evidence submitted. In the presentation of the Milwaukee case it became apparent, according to Mr. Duffy, that under existing conditions, including the high cost of labor and material, the demands of the public in relation to service, and the demands of the municipality, it is a grave question whether the average city electric railway can haul people at 5 cents a head and secure a reasonable return on the investment, this return to include proper operating expenses, the due share of city taxes, and a proper provision for reserves of all character, especially depreciation and amortization of the franchise, so that the investment made by the stockholders may be held intact.

In the old days electric railway companies boasted of operating for 40 per cent, 50 per cent or 60 per cent of the gross receipts, but they did not know how to keep their accounts. Such matters as setting aside a proper amount for depreciation, amortization and unknown contingencies were not taken into account, or only dimly and partially taken into account. Compared with other industries, a very high proportion of the actual values of public utility companies is on the tax books.

The speaker alluded to the history of the Chicago City Railway Company, with which he was formerly connected. In 1905 this company operated 220 miles of track and was earning from 12 per cent to 15 per cent on $18,000,000 of capital stock and paying 9 per cent. The company had no bonds, and it was considered that from the standpoint of transportation and of earning power no other company in the United States approached it. In the year mentioned, J. P. Morgan & Company, of New York, supposing the company had a long franchise, bought and paid $200 a share for the stock. The next year the courts decided that the franchise did not run until 1959, as was supposed. What happened? The famous Chicago traction settlement ordinance was adopted, and after the owners had put about $40,000,000 into the property, for there had been some betterments since $36,000,000 was paid for the stock, the company was allowed $21,000,000 in the franchise settlement. This instance shows the necessity of preserving the investment in public utility companies—the investment not only in the physical property, but in intangible things, which may be affected by unforeseen contingencies. This possibility must be taken into account, just as the wages of conductors and motormen are taken into account.

It takes very careful management for a street railway company to operate for a 5-cent fare or for an interurban company to operate at 2 cents a mile. These should be the minimum rates, or rather, the basic rates. It is of the greatest importance that the companies study the situation and find out the true cost of conducting their business. Electrical operating companies are producers of rides and electrical energy. They must at all hazards find out all the elements entering into the cost in order to determine the proper rates.

Mr. Duffy spoke of the Cleveland street railway situation. He knew Tom Johnson, and gave some account of his early career when Mr. Johnson was in the street railway business, but did not operate on a 3-cent fare. Mr. Duffy was of the opinion at the time of the Cleveland agitation that Mr. Johnson could not do so in Cleveland, and especially as at that time Mr. Johnson was operating a company in Allentown, Pa., on a 5-cent fare. The speaker was emphatic in saying that street railway companies cannot carry passengers for 3 cents. He does not believe they can do so for 5 cents, really, although it is a fact that, including transfers, people are being charged only 3.15 cents in Milwaukee. Statistics were given of the Milwaukee street railway systems, and it was shown that, exclusive of provisions for contingencies, it costs 3½ cents a passenger to carry the people.

Unless the cost of carrying passengers can be reduced, Mr. Duffy does not believe that the street railway companies of the United States can continue to do business at the present prices. Something must be done—either for the establishment of a zone system of fares, the readjustment of the transfer system, or something else. The companies themselves are to blame for the situation. Until very recently they did not themselves know what their cost actually was.

Turning to Massachusetts it was remarked that if the companies in that State had not made their rates too low there would be no necessity of raising them. The same observation applies to Oshkosh, Wis., where the interurban company has asked the State commission for an increase of rates. The steam railroads have uniformly tried to uphold their passenger rates, and Mr. Duffy admired them for it. In concluding this portion of his address, he again asserted with emphasis that electric railway companies should not consider anything less than a basic rate of 2 cents a mile on interurbans, with a 5-cent minimum.

Mr. Duffy concluded his interesting address by a discussion of rates for electric light and power. In this service the speaker believed in a liberal and flexible schedule as well as a comparatively simple scale of rates, and referred to the rates in use in Milwaukee, where the price for electricity used for lighting varies from 12 cents to 4 cents a kw-hour, depending on the consumption, and the rate for electricity used for power varies from 8 cents to 3 cents per kw-hour. The fundamental question is to make a cost analysis covering all elements that enter into the service. Still, it is essential to put out a practical, flexible schedule of rates for electric service. The company ought to have such an installation in the power house and such a rate schedule that nobody shall have an excuse for making his own electrical energy.

RAILWAY TESTIMONY FROM MANITOWOC

Thomas Higgins, president of the Manitowoc & Northern Traction Company, of Manitowoc, Wis., agreed with Mr. Duffy that a mistake was often made in the early days of electric railroading in establishing too low rates on interurban lines. For instance, on the line connecting Manitowoc and Two Rivers a 10-cent rate was made in the early days, with a 5-cent rate in the city of Manitowoc. A year ago it was decided to increase the interurban rate to 15 cents. There was no objection on the part of the citizens generally, but some politicians got busy and secured an injunction. The case came up in court and the judge recommended that it be taken to the Supreme Court. The city refused to give an appeal bond to indemnify the company in case the decision was favorable to the latter, and therefore the case was dismissed. The increase in rates has been established, and the travel has not diminished.

Commenting on the general situation, Mr. Lord said there was something like a mania for reducing rates, both for electric service and in the electric railway business. The people

sometimes clamor for reduction; public utility companies are good targets, and too often they give way to the pressure of the public. In this rate situation the companies should be very careful, not arrogant or grasping, but safe. The holders of the securities have a right to expect payment in full. This expectation cannot be realized unless there is an adjustment of rates on a policy involving 100 cents on the dollar.

INCREASE IN INTERURBAN RATES FROM OSHKOSH

J. P. Pulliam, of Oshkosh, manager of the Wisconsin Electric Railway Company, told how his company had raised its interurban rates within the last few months. The company operates several interurban lines. One of them, between Oshkosh and Neenah, is 15 miles long. The rate of fare has fluctuated rather curiously. Originally it was 20 cents, then it was increased to 25 cents, then decreased to 20 cents and recently has been again increased to 25. With the increased rate the actual amount of traffic has shown increase also. The line from Oshkosh to Fond du Lac is 18 miles long and the rate here has been raised from 30 cents to 35 cents. The rate of fare on the line to Omro has also been increased. In every instance the traffic has increased following the increase in rate of fare. In Oshkosh there is a straight 5-cent fare, with universal transfers. A workingman's rate of 3 cents is made between the hours of 6 and 7 a. m. and 6 and 7 p. m. The local conditions are such that the street railway system is badly laid out, and the rate of fare should be 6 cents, or really 7. In Fond du Lac the conditions are such that the company can make a fair profit at a 5-cent fare.

BUSINESS AND ENTERTAINMENT FEATURES

After adjournment on Tuesday afternoon some of the delegates enjoyed the bathing facilities provided. In the evening there was an enjoyable open-air concert at Electric Park, the Wisconsin Electric Railway Company supplying a special car for the trip and making all other arrangements.

At the Wednesday morning session an invitation was received from William Wallen, manager of the Oshkosh Gas Light Company, to inspect the Oshkosh central station, which this company owns. Later in the day several of the visitors availed themselves of this invitation.

Vice-President Lord and Secretary Allen brought up the question of the payment of dues. The dues of active paying members are one-twentieth of 1 per cent of the gross business of the preceding year, or of the electric light, power and railway departments of joint companies. There was a general discussion on the scope of the association. It was pointed out that its educational work is very important. It should educate the people and the legislators of the State on the real conditions of the electric light and railway business. Ernest Gonzenbach, of Sheboygan, moved that a pamphlet be prepared giving the constitution and by-laws and list of members of the association, together with other information about the organization, to be printed for general distribution. This motion was adopted.

CONCLUDING BUSINESS

Secretary Allen said that his office receives many requests for information, and he might undertake to furnish the members the important rulings of the State Railroad Commission if desired. The secretary might also establish a sort of employment exchange, bringing unengaged men and open positions together.

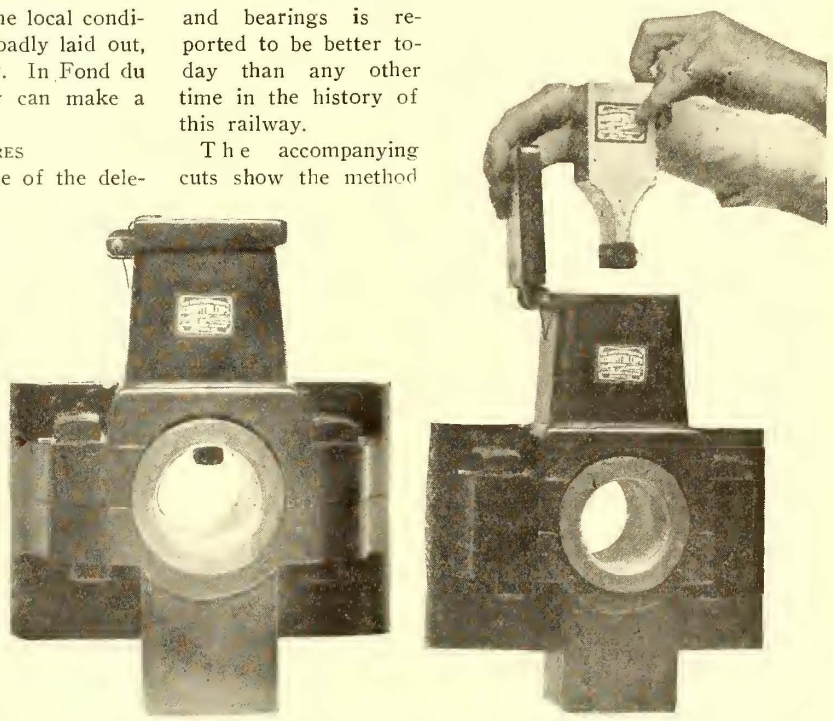
Mr. Allen also mentioned the fact that the Madison Gas & Electric Company, of Madison, Wis., has been most helpful to the association in days past, and that it would be an act of simple justice for the association to show its appreciation in some manner. On motion, the matter was made a special order for the annual convention of this association to be held in Milwaukee next January.

The thanks of the association were extended to the Wisconsin Electric Railway Company, and particularly to Mr. Pulliam, of that company, the Oshkosh Gas Light Company, and particularly to Mr. Wallen of that company, and also to the Oshkosh Yacht Club for extending the courtesies of its beautiful building.

AN ECONOMICAL OIL CUP

The accompanying illustrations show the "Economy" oil cup, made by the Economy Oil Cup Company, Augusta, Ga., to eliminate grease lubrication. The cup is of the felt base type, and was invented by E. M. Crozier, now superintendent of the Augusta-Aiken Railway. Before the cup was tried the cost of motor lubrication on the Aiken division was as much as $1.14 per 1000 car-miles. The new cups were first placed on a number of trial cars during May and June, 1908, and by their use Mr. Crozier succeeded in reducing the charge of lubricating to about 70 cents per 1000 car-miles, with less than one-third of the cars on this division using this cup. In view of this result the Augusta-Aiken Railway & Electric Company at once equipped its entire system with the new cup, thereby reducing the lubricating cost to 18 cents per 1000 car-miles. The condition of armatures and bearings is reported to be better today than any other time in the history of this railway.

The accompanying cuts show the method of installing the cup and the simplicity of its construction. The body is composed of block tin shaped to fit the old grease box and made in various sizes to conform to different style motors. The felt base fits the bearing slot and rests upon the shaft to which it conveys the oil. The weight of the cup causes it to follow the shaft as the felt wears, thus assuring a free and constant uniform feed of oil. The base is made of one piece of sheet felt extending up into the body of the cup, as shown in one of the cuts; all oil passes through this base direct to the shaft, thus preventing dirt, grit or dust from entering the bearing. There is no drip from the bearing when the cars are standing in the car-house or stations along the road, as the cup feeds oil only when the shaft is in motion. The oil does not leave the cup until the shaft is reached. It cannot leak out around loose bearings, as the cup rides the shaft at all times with the felt base below the top of the bearing slot. The removable feature of this cup permits inspection of the bearing at all times simply by lifting the grease box lid. It has been found that an oiling of one-half gill per bearing will furnish perfect lubrication for operating over 37 hours, or 275 miles to 300 miles.



Oil Cup with Felt Base, Showing Application to Bearing

THE USE OF COMMUTATING POLE MOTORS IN THE UNITED STATES

The General Electric Company has just issued some statistics on commutating pole railway motors, which were introduced about four years ago. The sales of this type by the largest two railway equipment manufacturers in this country were 17 per cent of the total number of railway motors sold by them in 1907, while in 1908 and 1909 this increased to 51 per cent. These motors, varying in size from 50 hp to 275 hp, are operating successfully in all parts of this country and Europe under various service conditions. It is held that the improved commutation and protection against flash-overs afforded by commutating poles has made possible the very satisfactory results in decreased maintenance of commutators, brush holders, brushes and windings.

The average non-commutating pole motor cannot be relied on for more than 50 per cent to 75 per cent current overload when the car is required to make up lost time, accelerate on heavy grades or meet other emergency conditions. On the other hand, the commutating pole motors as a type will take care of from 150 per cent to 200 per cent overload for emergency intervals without apparent injury.

The following data on the performance of recent locomotives will illustrate to what extent these overloads have proven practical. It is assumed that in the great majority of instances the locomotive starts are made at the slipping point of the wheels.

Road	Type motor	Amp. rating	Weight per driver	Amp to slip 25% coef.	Amp to slip 30% coef
Detroit River Tunnel.....	GE-209	400	50,000	525	610
Baltimore & Ohio Railroad..	GE-209	400	45,000	650	750
Chicago & Milwaukee Electric Railway	GE-205	144	18,000	310	360

Some of these locomotives have been in operation over two years, and as far as known these overloads have shown no injurious effects. Less wear of commutator might reasonably be expected with the decreased sparking as the etching effect of the spark is largely accountable for this wear. The following figures are taken from car equipments in actual service:

Road	Motor	voltage	Motor mileage per motor
Indianapolis & Louisville Traction Company.	GE-205	600/1200	200,000
Pittsburg, Harmony, Butler & New Castle Electric Railway	GE-205	600/1200	200,000
Third Avenue Railroad, New York.....	GE-210	600	70,000
Chicago Railways	GE-216	600	50,000

On none of these roads has the commutator wear been enough to be distinguishable by the eye or enough to enable one to feel any indication of a ridge on the commutator. It is safe to say that the life of the commutators is at least five times as long as that of non-commutating pole motors. The life of brushes has also been greatly increased owing to the smoother commutator and decreased burning of the brush. The local current on the face of the brush may amount to as much as the actual line current, and is largely responsible for the deterioration of the bearing surface; this local current is greatly reduced in commutating pole machines.

Records of brush wear on the same roads and motors mentioned above indicate 1 in. wear for about 150,000 miles running for the city equipments and 750,000 miles for the interurban equipments. Non-commutating pole motors showing one-half of these mileages might be considered as doing very well. This represents a material saving in cost of brushes as well as in time saved in inspection. With less copper and carbon dust it follows conclusively that a cleaner, safer motor and one requiring less attention is obtained.

The first General Electric 1200-volt motors were put in operation on the Indianapolis & Louisville line in October, 1907, and since that time about 40,000 hp in 1200-volt motors have been installed on some eight different roads. These motors and the entire equipment are operating in a manner which seems to indicate the entire practicability of the higher voltage for railway work, though the commutating pole becomes a practical necessity with motors designed for use on this voltage.

ASSOCIATION BULLETIN ON CONVENTION ARRANGEMENTS WITH ATLANTIC CITY HOTELS

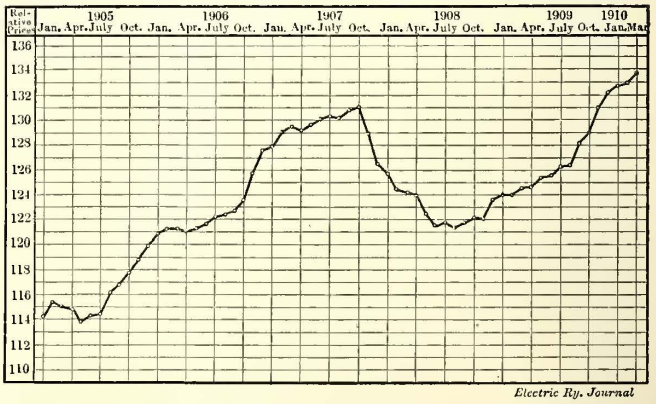
The American Street & Interurban Railway Association has issued Convention Bulletin No. 2, which describes the arrangements for the Atlantic City convention with particular reference to the hotels. As in 1908, Young's Million Dollar Pier will be used for exhibits and most of the convention meetings will be held there. The Marlborough-Blenheim has been selected as the headquarters of the American Association and the Manufacturers' Association. The Accountants will establish headquarters at the Chalfonte, the Engineering Association at the Dennis, the Claim Agents and Transportation & Traffic Associations at the Traymore. A list is published of the principal hotels in Atlantic City, together with rates for the different classes of rooms. Hotel reservations should be arranged directly with the hotels, and to avoid error statement should be made that the reservation is desired in connection with the convention. The special rates made by the hotels have been given with the understanding that the hotel charges will be for the full time of reservation. The hotels have agreed to provide a detailed list of their room numbers and respective rates, which will be in the hands of a committee as a check-up in registration hours during the convention. If information of this kind is desired prior to the convention week it may be obtained by communicating with the secretary's office for the American and affiliated associations and with W. L. Conwell, 165 Broadway, New York, for the Manufacturers' Association.

The present bulletin includes illustrations of Young's Pier and a plan of the boardwalk and vicinity showing the location of the hotels and piers. It is announced in conclusion that details of transportation, programs, meeting halls and other convention subjects will be treated in subsequent bulletins.

PRICES OF COMMODITIES

Bulletin No. 87 of the Bureau of Labor of the Department of Commerce and Labor, giving prices of a large number and variety of raw and manufactured commodities, has just been published. This bulletin is supplementary to bulletins 71, 77 and 81 issued by the same bureau, and brings the records of prices quoted up to March, 1910. The figures are particularly interesting because of the effect of high prices of commodities on the operating expenses and cost of construction of electric railways.

[Average price for 1890 to 1899 = 100.0]



Relative Prices of all Commodities by Months from January, 1905, to March, 1910

Bulletin 87 contains a chart, from which the accompanying diagram is reproduced, and gives in graphical form the figures quoted on page 25 of the last issue of this paper. As shown, the prices were higher in March, 1910, than at any other period shown on the chart and this includes the entire period since 1890 for which records have been compiled. Prices were higher even than in October, 1907, which constituted the period of highest prices up to that time.

News of Electric Railways

The Detroit Situation

Mayor Breitmeyer, of Detroit, Mich., is preparing a special message to the City Council which will review the traction situation in Detroit and contain suggestions to the Council for action looking toward a settlement of the minor controversies that have seriously interfered with the progress of the negotiations between the city and the Detroit United Railway. Frederick T. Barcroft, who appraised the property of the company in the interest of the city, but refused to defend his figures, has been in communication with the Mayor, and has now stated that when the Council is a party to the proceedings he will permit the organization which assisted him in his original work to resume its labors on behalf of the city. In response to the request of the Mayor that he outline some procedure for the Mayor to submit to the Council for approval, Mr. Barcroft has written the Mayor a letter in which he says that the city should decide definitely upon the following:

"1. Council should state what the city wants; then, being advised by its legal department, the disposition of the matter will be proper, sane, legal and just.

"2. A purpose having been established to which the valuation is to be applied, it can be kept constantly in mind in its application and the subject ended.

"3. Is more than a scrap value to be given the lines upon which franchises have expired?

"4. Are the original costs to be applied on this property or the 1909 prices on the few lines where the franchises have not expired?

"5. Are all the old cars in operation to be included, or just the modern ones?

"6. Are the power houses to be included? If so, is their present usefulness to be the basis of judgment of their value?

"7. Are all the buildings the company owns to be included, or only those of modern construction, used for railway purposes?

"8. Are both shops to be included precisely as they are without analysis of what they are used for, or is the fact to be recognized that two-thirds of their force and equipment is utilized for the care of interurban and small suburban town cars in the vicinity of Detroit?

"9. Are overhead charges to be considered at all on lines where franchises have expired? Are overhead charges to be figured on a basis of the original cost of the Pack-Everett lines applied to the D. U. R. system, or a basis of 1909 prices?

"10. Is the real estate to be charged at its value when purchased, or 1909 prices?"

According to Mr. Barcroft, to carry out the work based on these questions would involve a further outlay by the city of $10,500.

The company has replied to the communication from the city which contained the two resolutions adopted by the City Council, one under date of June 14, 1910, requiring the company to pay $50 a day additional to the city, and one under date of June 21, 1910, requiring the company to make a further payment of $100 per day for the privilege of operating on streets on which the franchises are said to have expired. The company said substantially:

"We are compelled to advise you that we deny the statement contained in the preamble in each resolution to the effect that the rights of the company have expired on the streets mentioned in said resolution. We are also advised that the requirements to pay said sums of money are illegal for other reasons. We are therefore compelled to advise you that we must decline to pay said sums.

"Perhaps it may not be inappropriate to say to you that the increase of the ad valorem tax which has been made this year, added to the excessive demands now being made, has prevented us from completing our arrangements for borrowing the money necessary to make all the extensions required by your recent resolutions which we accepted. These resolutions, with other necessary improvements and betterments which we have contemplated, call for the expenditure of nearly $2,000,000. The addition of such burdens as you seek to impose upon us and the threat to add still others puts it beyond our power to raise the money for the purposes above indicated.

"When your honorable body adopted the resolution regarding the payment of $300 per day, we then advised you that we did not regard the requirement as a legal one, but in the hope of avoiding litigation and further friction between us, and without waiving our legal rights, we have paid that sum, and for the present will continue to pay it, under the conditions named in our letter advising you that we would. This was with the belief that no further burdens would be added.

"We do not believe that you have fully considered the necessary effect of the imposition of these heavy financial burdens upon the company, and therefore respectfully call your attention to it.

"We believe we should again call your attention to the failure of the city to maintain the track properly, and paving foundations, and the paving on the lines known as the Detroit Railway system, and in this connection we beg to call your attention to our letter to his honor, the Mayor, concerning this matter. This company is at all times ready to co-operate with your honorable body in bringing about a better state of affairs concerning these and all other street railway lines in this city, consistent with a reasonable protection of the property in its charge."

Cleveland Traction Situation

J. J. Stanley, president of the Cleveland Railway, has asked the City Council for an increase of 1 cent per car mile in the allowance for operating expenses to cover the advance in the wages of motormen and conductors, made by the board of arbitration. The city named G. M. Dahl, street railway commissioner, to represent it in conference with the officers of the company regarding the matter. Mr. Dahl opposed the increase. Mr. Stanley says that the additional cost of operation must be defrayed. Refusal on the part of the city to make a change of this kind in the ordinance would remove the obligation of the company to the men by imposing conditions on the company that are impossible. The legislative committee of the Federation of Labor called upon Mr. Dahl on June 30, 1910, and urged that he place nothing in the way of the advance that has been recommended in wages.

Owing to the supposed unsafe condition of the Superior Avenue viaduct draw, Mr. Stanley has instructed conductors to give transfers good over the Central viaduct, from West Side lines, if passengers desire them. The Superior viaduct may be abandoned as soon as connections are completed between the Abbey Street and other West Side lines.

A number of accidents have occurred recently because people put their heads through the car windows on the devil strip side, and orders have been issued that the last two windows on the side of all cars be kept closed. The wire grills which at present extend well up the windows of the cars, will probably be extended so as to inclose the whole window.

Traction Fund in Chicago Applicable to Subway Work

The Supreme Court of Illinois has sustained the decision of Judge Carpenter of the Circuit Court that the City of Chicago is authorized to use for building subways the fund of about $4,500,000, which has accumulated as a result of the participation of the city in the earnings of the Chicago City Railway and the Chicago Railways. The decision of the Supreme Court says in part:

"Our conclusion is that the city has power to acquire or construct street railways, and that street railways, properly construed, mean elevated, surface or underground railways; that the City of Chicago may exercise this power in ac-

cordance with the traction ordinance of 1907, and may expend for such purpose either the special traction fund or any other available corporate funds belonging to the city.

"No one would seriously contend that a city had the right to grant the exclusive use of its streets to a street railway, and thus compel all persons who used the street to travel upon the street cars of such company.

"No such unlimited grant is contemplated by the traction ordinances. The clear meaning of the ordinance is that the city will not permit any other street car company to use the tracks in the subway that are leased to the present traction companies.

"We have no doubt that if the city owned a certain street railway it would have the right to lease such track and give the lessee the exclusive right of operating its cars upon such track, but the rights of the public in the street would be the same as they are where the street railway owns its own tracks."

Ohio State Board of Arbitration and Threatened Strike at Columbus

The employees of the Columbus Railway & Light Company, Columbus, Ohio, who claim that the company has discriminated against them, have asked Governor Harmon to remove Judge Noah H. Swayne and Joseph Bishop from the State Board of Arbitration. Judge Swayne had been reappointed a few days previously, but resigned when he heard that the men objected to him. The law provides that the Governor shall appoint one person to represent the employers and one to represent labor, and that these two shall recommend a third to be appointed by the Governor. It was alleged that Judge Swayne does not represent the employers of labor. Mr. Bishop is affiliated with an association composed of iron, steel and tin workers, and was appointed a member of the board by William McKinley when he was Governor of Ohio. The motormen and conductors say that he is not an employee and was not an employee at the time of his appointment. Attorneys representing the carmen conferred with Governor Harmon about the removal of Mr. Bishop, who intimated that he would not tender his resignation. They claimed that labor has been dissatisfied with Mr. Bishop for several years, but that complaint had not been made before because the board had not arbitrarily ordered a hearing. The Governor stated that he would take no action until he had an opinion from the Attorney-General. That official says that Mr. Bishop is technically an employee, and the Governor has refused to remove him. Albert F. Sparks, general manager of the James Leffel Company, Springfield, Ohio, manufacturers of water wheels, has been appointed to succeed Judge Swayne on the board.

New Indiana Road Opened.—The Indianapolis, New Castle & Toledo Electric Railway, New Castle, Ind., which connects Indianapolis, Greenfield, New Castle, Muncie, Richmond, Winchester and Toledo, was placed in regular operation on June 28, 1910.

Franchise Matter at Toledo.—The proposal of Mayor Whitlock, of Toledo, that an inventory should be made of the property of the Toledo Railways & Light Company was considered by the directors of the company at their meeting held during the week ended July 2, 1910, but no decision was reached.

Interurban Terminal in Columbus.—The Columbus Interurban Terminal Company, incorporated by J. B. Foraker, Jr., F. A. Healy, Dana Stevens, W. H. McAllister and W. Kesley Schoepf, with a capital stock of $10,000, will erect an interurban station and provide an interurban terminal at Third Street and Town Street, Columbus, Ohio.

Some Changes in the Space Numbering at the Atlantic City Convention.—The American Street & Interurban Railway Manufacturers' Association has just issued a circular giving the plans of the pier at Atlantic City, which show a slight change in the numbering of the spaces at the end of the pier. The circular also gives the dimensions for all of the booth spaces, head room and area, and complete instructions for applying for space.

Decision Against Chicago City Railway.—The Supreme Court of Illinois has decided in favor of Clarence H. Venner in his mandamus proceedings against the Chicago City Railway for an inspection of its books and records, and has reversed the decision of the Appellate Court, which was in favor of the company. The company contended that it was not subject to the general corporation law entitling stockholders to such inspection, because it was incorporated by special charter before the corporation law was passed. This contention the Supreme Court has overruled in the decision just rendered.

Unused Tracks Not a Trespass in New York.—Justice Erlanger, in the Supreme Court, has sustained a demurrer interposed by the receiver of the Fulton Street Railroad, New York, N. Y., to the complaint in a suit brought against him and the company by the city of New York for the removal of the tracks of the corporation, on the ground that they constitute a trespass and a nuisance. The company was authorized to operate a street railway along Fulton Street, West Street and other streets. The grant, or franchise, was originally acquired by the North & East River Railway, and was subsequently transferred to the Fulton Street Railroad. The basis of the action was that no cars had been run on the line since June 1, 1908.

Spokane Transportation Club.—At the meeting of the Spokane Transportation Club, on June 17, 1910, the subject of through billing was discussed with particular reference to the billing of freight direct from New York and Chicago to points on the Spokane & Inland Empire Railroad. Other subjects considered were largely of interest to the steam railroad officials in attendance. It was voted to accept the invitation extended by Waldo G. Paine, second vice-president and traffic manager of the Spokane & Inland Empire Railroad, and J. C. White, of the Red Collar Steamboat Line, to hold the annual outing of the club on July 20, 1910, on the St. Joe River. The cars of the Spokane & Inland Empire Railroad will be used as far as Coeur d'Alene. The party will then journey by boat on Coeur d'Alene Lake to the mouth of the St. Joe River.

Electric Railways in Michigan.—The State Railroad Commission of Michigan reports that in the year ended Dec. 31, 1909, 19 electric railways, with 1268.90 miles of track, were operated in Michigan. The cost of the electric railways up to June 30, 1909, was $90,591,665. Only 8.19 miles of new track were laid during 1909. The electric railways have $38,693,100 of stock outstanding par value. The dividends last year amounted to $90,901.79. The income statements showed 12 companies with a surplus for 1909 of $3,632,308, while seven had a deficit of $211,551. The total passenger revenue of the electric railways was $9,713,275.37, and the total revenue from transportation $10,500,523. The operating expenses were $6,500,745. There were 7153 employees on the electric railways of the State, including 98 general officers, 223 clerks, with 29 superintendents. There were 1726 passenger cars and 544 other cars in use. During the year 43 persons were killed and 375 were injured. Five passengers were killed and 222 were injured.

San Francisco Municipal Railway Bonds Declared Legal.—The Supreme Court of California handed down a decision on June 25, 1910, in which it was declared that the course of the city officials of San Francisco in connection with the plan to issue bonds for the reconstruction of the Geary Street, Park & Ocean Railway by the city has been regular and construed the city charter and the State Constitution in such a way that no question is left as to the city's right to construct, complete or purchase a municipal street railway. The decision says: "Whatever basis there may be for the doubt expressed as to the wisdom of the policy of the acquisition and operation by the City and County of San Francisco of the proposed municipally-owned street railways, we have no doubt that the city and county has the power to construct and operate the same and the power to incur a bonded indebtedness for such purpose, and also that the proceedings in that behalf presented for review on the appeal are free from substantial irregularity. It necessarily follows that the conclusion of the trial court was correct. The judgment is affirmed, as is also the order denying the plaintiff's motion for an injunction." The Board of Supervisors of San Francisco has set the date for receiving bids for the bonds for July 11, 1910. The first issue of bonds will be $260,000, and will provide funds sufficient for getting the work on the municipal line started.

Financial and Corporate

New York Stock and Money Market

When the market reopened this morning after the three-day holiday Wall Street was hopeful that the persistent selling pressure would be lifted. The opening sales were at advances, but almost immediately large quantities of stock were offered and rapid declines followed, there being little professional support. Several of the more active issues made new low records for the year, and many were only fractionally higher than the low point of June 30. There was a slight recovery at the close, but net losses were generally recorded for the day.

Money was easy at: Call, 2 to 3¼ per cent; 90 days, 3¾ per cent.

Other Markets

The Philadelphia market was affected by Wall Street to-day, and was generally lower with considerable selling pressure. Rapid Transit has declined about 1 point and Union Traction less than 2 points.

Massachusetts Electric issues and Boston Elevated have been fairly active in the Boston market both before the holidays and to-day. There has been some pressure to sell these issues and they have declined under the liquidation.

In the Chicago market, the Elevated issues were affected by Mr. Blair's announcement that conditions were unfavorable for the proposed elevated consolidation. Metropolitan preferred, which sold a week ago at 70, closed to-day at 58½, and the common, which sold at 24 a week ago, closed at 20. South Side Elevated dropped to-day from 69 to 55.

There continues to be some buying of United Railways certificates in the Baltimore market, but the price remains about 13½ to 14. Bond prices are unchanged.

Quotations of various traction securities as compared with last week follow:

	June 28.	July 5
American Railway Company	a44	a42½
Anrora, Elgin & Chicago Railroad (common)	a60	a*60
Aurora, Elgin & Chicago Railroad (preferred)	a91	*91
Boston Elevated Railway	a126	a126
Boston & Suburban Electric Companies	a14	*14
Boston & Suburban Electric Companies (preferred)	a74	*74
Boston & Worcester Electric Companies (common)	a10½	a10½
Boston & Worcester Electric Companies (preferred)	a40	a40
Brooklyn Rapid Transit Company	76¾	73⅞
Brooklyn Rap. Transit Company, 1st pref. conv. 4s	83¼	82
Capital Traction Company, Washington	a129½	a130
Chicago City Railway	a195	a195
Chicago & Oak Park Elevated Railroad (common)	*3¼	*3¼
Chicago & Oak Park Elevated Railroad (preferred)	*7¼	*7¼
Chicago Railways, ptcptg., ctf. 1	a75	a75
Chicago Railways, ptcptg., ctf. 2	a17	a17
Chicago Railways, ptcptg., ctf. 3	a11	a11
Chicago Railways, ptcptg., ctf. 4s	a6½	a6½
Cleveland Railways	*91½	*91½
Consolidated Traction of New Jersey	a76	a75
Consolidated Traction of N. J. 5 per cent bonds	a103	a103
Detroit United Railway	*50½	*50½
General Electric Company	143	140
Georgia Railway & Electric Company (common)	a108	a108
Georgia Railway & Electric Company (preferred)	a87	a87
Interborough-Metropolitan Company (common)	18	17
Interborough-Metropolitan Company (preferred)	49½	49
Interborough-Metropolitan Company (4½s)	80	79½
Kansas City Railway & Light Company (common)	a25	a25½
Kansas City Railway & Light Company (preferred)	a73	a73
Manhattan Railway	130	125
Massachusetts Electric Companies (common)	a15⅞	*15⅞
Massachusetts Electric Companies (preferred)	a80	*80
Metropolitan West Side, Chicago (common)	a23¾	a23½
Metropolitan West Side, Chicago (preferred)	a70	a58½
Metropolitan Street Railway	*15	*15
Milwaukee Electric Railway & Light (preferred)	*110	*110
North American Company	68	65
Northwestern Elevated Railroad (common)	a22	a25
Northwestern Elevated Railroad (preferred)	a65	a63
Philadelphia Company, Pittsburg (common)	a48	a42½
Philadelphia Company, Pittsburg (preferred)	a43¾	a43
Philadelphia Rapid Transit Company	a19⅞	a18⅛
Philadelphia Traction Company	84½	84½
Public Service Corporation, 5 per cent col. notes	a96	a96
Public Service Corporation, ctfs.	a101	a100
Seattle Electric Company (common)	a110	*110
Seattle Electric Company (preferred)	a100	*100
South Side Elevated Railroad (Chicago)	a72¾	*72¾
Third Avenue Railroad, New York	a7⅜	7½
Toledo Railways & Light Company	8	6¾
Twin City Rapid Transit, Minneapolis (common)	109½	106¾
Union Traction Company, Philadelphia	a46	a44¾
United Rys. & Electric Company, Baltimore	a14¼	a14½
United Rys. Inv. Co. (common)	30	*30
United Rys. Inv. Co. (preferred)	55	50
Washington Ry. & Electric Company (common)	a33½	a33½
Washington Ry. & Electric Company (preferred)	a88	a87½
West End Street Railway, Boston (common)	a88	a88
West End Street Railway, Boston (preferred)	a100	a100
Westinghouse Elec. & Mfg. Company	62	60
Westinghouse Elec. & Mfg. Company (1st pref.)	*125	*125

aAsked. *Last Sale.

Progress of Metropolitan Street Railway Reorganization

It is expected that the plan for the reorganization of the Metropolitan Street Railway, New York, N. Y., prepared by the bondholders will be submitted to the Public Service Commission of the First District of New York for consideration on July 11, 1910. No official statement in regard to the details of the plan has been made, but it has been estimated that $12,000,000 will be required to meet the present needs of the company. Of this amount $5,500,000 will probably be available as a result of the offer made to W. W. Ladd, receiver of the New York City Railway, to end the litigation brought by him against the Metropolitan Securities Company and the Interborough-Metropolitan Company. The remainder of the $12,000,000 will be secured by assessing the stock of the Metropolitan Street Railway, for which income securities will be offered. It is, of course, expected that the stock of the Metropolitan Street Railway will be scaled down. It is proposed to refund the existing $12,500,000 of 5 per cent bonds of 1898, and the $16,000,000 of 4 per cent bonds of 1902, and to care for the accident judgments held by the tort creditors of the New York City Railway. The tort creditors of the Metropolitan Street Railway proper, whose claims have grown out of accidents since the receiverships of September, 1907, are not affected by this settlement. Such tort claims are being met, as they accrue, as a part of the operating expenses of the road. According to the New York *Times*, it is expected that there will be an increase in gross earnings of about 3.5 per cent a year and that the operating ratio, with the present burden of taxes and rentals, will be about 70 per cent of the gross. That gives the following estimated income, applying the percentages to the figures compiled by Chairman Tripp, of the reorganization committee, as of Dec. 31, 1909:

Gross from operation, $13,258,412 for 1909, plus 3.5 per cent.	$13,722,448
Operating cost and taxes, (70 per cent)	9,605,711
Net from operation	$4,116,737
Interest and rentals on underlying securities	2,353,978
Net income	$1,762,759
Other income	200,000
Gross income	$1,962,759
Interest (6 per cent) on $12,000,000 new cash	720,000
Balance applicable to existing 4s and 5s	$1,242,759

Following the announcement that the bondholders' committee was soon to submit to the Public Service Commission a plan of reorganization which involves a discontinuance of the litigation between the receivers and the Interborough-Metropolitan Company and the Metropolitan Securities Company interests, Robert W. de Forest made the following statement:

"The plan has received the approval of the bondholders' committee and is now before Judge Lacombe.

"The gentlemen who are providing the funds for this adjustment have been actuated by a desire to terminate the costly and vexatious litigation which has been in progress throughout almost the entire period of receivership and to enable the early reorganization of the Metropolitan properties in the interest of both the security holders and the public. Another important reason for the adjustment, which commends itself to all, is that it seems to afford, through the action of the bondholders' committee, the only means of providing relief for the holders of personal injury claims who have recovered judgments against the New York City Railway to the amount of almost $2,000,000, whose judgments would otherwise have been been rendered valueless by foreclosure. The salient features of the adjustment are as follows:

"The sum of $5,500,000 is paid to the receivers in settlement of the claims of the receivers against the Metropolitan Securities Company and through that company against the Interborough-Metropolitan Company, its principal stockholder, representing the balance of the purchase price of $8,000,000 of Metropolitan Street Railway Company improvement notes issued prior to the receivership and on account of the purchase price of which only about $3,000,000 had been paid at the time of the appointment of receivers, and also in settlement of the claim of the receivers of the New York City Railway, based upon the redemption at par of notes of the New York City Railway which had been originally issued at 70. The receivers claimed that the

Metropolitan Securities Company was liable to the extent of this difference, and they also contended that a corresponding liability rested upon directors, although they did not in any way individually profit from the transaction. Former directors have accordingly provided the sum of $1,500,000 as part of the general readjustment which terminates a litigation, the continuance of which might have prevented reorganization of the property for an indefinite length of time without offering any means of providing for the payment of the claims of those who had suffered personal injury through accidents.

"All pending litigation will be ended by this adjustment."

Theodore P. Shonts, president of the Interborough-Metropolitan Company, issued the following statement:

"The Interborough-Metropolitan Company has agreed to contribute to the settlement announced by Mr. de Forest, not as any part of a plan to participate in a reorganization of the surface lines, for that question has not been determined, but in order to put an end to all existing and threatening litigations against it.

"The Interborough-Metropolitan Company is the holder of about 97 per cent of the stock of the Metropolitan Securities Company upon which over $7,000,000 is still unpaid. As such stockholder it has been sued with the minority stockholders by the receiver of the New York City Railway to compel it and the minority stockholders to satisfy out of their personal stock liability the judgment amounting with interest to over $4,600,000 recovered by the receiver against the Metropolitan Securities Company. The receiver disputes the right of the Interborough-Metropolitan Company to any counterclaim to offset this liability. The company is also threatened with further similar litigations as the result of a pending suit brought by said receiver against the Metropolitan Securities Company, in which former directors of the New York City Railway are joined as defendants to recover with interest over $4,000,000 on account of the issue to the Securities Company of the New York City Railway debentures at 70 and their redemption by the New York City Railway at par. It is also threatened with litigation by the receiver of the Metropolitan Securities Company in aid of the collection from the Interborough-Metropolitan Company of the said judgment and claims of the receiver of the New York City Railway.

"To put an end to this litigation, existing and threatened, the Interborough-Metropolitan Company has made a cash contribution of $4,000,000 in the form of payment upon its stock liability, the cash for this purpose being raised by the sale of its five-year 6 per cent notes at par. The remainder of the sum required, $1,500,000, has been contributed by certain of the directors of the New York City Railway already referred to.

"The Interborough-Metropolitan Company also releases the New York City Railway and the Metropolitan Street Railway from certain uncollectible claims, and agrees not to participate directly or indirectly in the receivers' funds; but it retains all its valuable collateral. As a result of the settlement, provision has been made by the bondholders' committees of the Metropolitan Street Railway, subject to the approval of the Public Service Commission."

Judge Lacombe, in the United States Circuit Court, has adjourned the sale of the property of the Metropolitan Street Railway under foreclosure until Sept. 27, 1910.

Sale of New Jersey Line

Thomas N. McCarter, president of the Public Service Corporation of New Jersey, announced on July 2, 1910, that the Public Service Corporation had acquired by purchase from Ford, Bacon & Davis, New York, N. Y., a large majority of the stock of the New Jersey & Hudson River Railway & Ferry Company and that the latter will hereafter be operated as part of the Public Service Railway. A meeting of the board of directors of the Hudson River Railway & Ferry Company was held in New York on July 2, 1910, at which the officers of the company resigned and the officers of the Public Service Corporation were elected to succeed them.

The New Jersey & Hudson River Railway & Ferry Company operated chiefly in Bergen County in territory which had not been touched by the Public Service Corporation's lines. It also controlled the Fort Lee Ferry from Edgewater, N. J., to the foot of West 130th Street, New York. It possesses more than 48 miles of track, nearly half of which is built on private right of way. The terms of the sale were not disclosed, but it is understood that the same offer made by the Public Service Corporation for the majority of the stock was extended to all of the stockholders of the New Jersey & Hudson River Railway & Ferry Company and that under it the Public Service Corporation will acquire practically all of the stock of the company.

Federal Light & Traction Company, New York, N. Y.—The Federal Light & Traction Company, the organization of which was noted in the Electric Railway Journal of June 11, 1910, page 1041, has filed for record a certificate of the increase of its authorized capital stock from $2,000,000 to $11,000,000, one-half of which is preferred.

Indianapolis & Cincinnati Traction Company, Indianapolis, Ind.—Judge Carter of the Superior Court has consented to have Charles L. Henry, receiver of the Indianapolis & Cincinnati Traction Company, file a petition on Aug. 20, 1910, for the sale of the property of the company. The hearing on the petition will be heard on Sept. 7, 1910. Mr. Henry reported to the court that all the holders of the $2,000,000 of outstanding bonds had signed agreements for the reorganization of the company except the holders of about $21,000 of the bonds.

International Traction Company, Buffalo, N. Y.—A committee consisting of H. H. Littell and George R. Teller, Buffalo, N. Y., and John W. Green, Louisville, Ky., has called for deposits of the 50-year collateral trust 4 per cent bonds of the International Traction Company with the Commonwealth Trust Company, Buffalo, N. Y., or the Columbia Trust Company, Louisville, Ky., or a trust company in New York to be designated later, in opposition to the plan announced in the Electric Railway Journal of June 25, 1910, page 1114. The committee contends that the plan previously outlined undertakes to obtain from the bondholders funds for improvements and extensions which should properly be contributed by the shareholders.

Nevada Water, Light & Traction Company, Nevada, Mo.—The Nevada Water, Light & Traction Company has been incorporated by Edward Willard, Clifford Phillips and Mary Hopkins, Nevada, Mo., and Harry C. Barker and W. W. Seibert, St. Louis, Mo., with a capital stock of $350,000, as the successor to the Missouri Water, Light & Traction Company, the property of which was sold recently under foreclosure to A. Mitchell, St. Louis, Mo.

Third Avenue Railroad, New York, N. Y.—F. W. Whitridge, receiver of the Third Avenue Railroad, has paid off $500,000 of receivers' certificates from cash on hand. Another $500,000 will be paid off shortly. This will leave outstanding $2,500,000 of the $3,500,000 of certificates which have been issued. This is the amount provided for in the proposed reorganization now under consideration by the Public Service Commission of the First District of New York.

Tampa-Sulphur Springs Traction Company, Tampa, Fla.—Control of the Tampa-Sulphur Springs Traction Company has been sold to new interests, and Walter L. Weston, New York, has been elected president of the company; Peter O. Knight, Tampa, vice-president and general counsel; B. F. Hathaway, treasurer; C. Fred Thompson, secretary. A. G. Turner, C. C. Whitaker and C. O. Brewster have been elected directors of the company.

West Penn Traction Company, Connellsville, Pa.—A special meeting of the stockholders of the West Penn Traction Company has been called for Sept. 1, 1910, to vote to increase the indebtedness of the company from nothing to $25,000,000 by executing a mortgage to secure an issue of bonds and to take action on the proposed agreement between the West Penn Traction Company and West Penn Railways as set forth in the amended proposition of the American Water Works & Guarantee Company, made to the stockholders of the West Penn Railways on Feb. 10, 1910, and accepted by the stockholders of that company on Feb. 23, 1910. A special meeting of stockholders of the West Penn Railways has been called for Sept. 1, 1910, to vote to authorize $6,000,000 of bonds. This is an increase of $6,000,000 over present bonded indebtedness. At the same time action will be taken on the proposed agreement between West Penn Railways and the West Penn Traction Company as set forth in the amended proposition of the American Water Works & Guarantee Company.

Traffic and Transportation

Manitowoc & Northern Traction Company Increases Fares

On April 20, 1909, the Manitowoc & Northern Traction Company, Manitowoc, Wis., announced an increase in the fare from 10 cents to 15 cents on its line between Manitowoc and Two Rivers, 7¾ miles distant, effective on May 1, 1909. Shortly after the increase went into effect an injunction was secured by the city attorney of Manitowoc on behalf of the city, restraining the company from charging more than 10 cents fare between Manitowoc and Two Rivers. On June 4, 1910, the injunction was dissolved and the case dismissed. The increase was therefore declared in effect on June 15, 1910, and the following notice was issued on June 8, 1910, in regard to the change:

"On April 20, 1909, the following announcement was made relative to fares on our cars:

"'On and after May 1, the fare between Manitowoc and Two Rivers will be 15 cents if paid on the car. City tickets will be sold as in the past, 24 for $1, and three of such tickets will be accepted as an interurban fare, making the fare when tickets are used, 12½ cents.

"'Those tickets will be sold at the National Bank of Manitowoc, at Kirst's drug store in Two Rivers, and at the office of the company. Workingmen's tickets will be sold as formerly at 7½ cents per ride, good on morning and evening cars going to and from work.

"'The increase of fare has become necessary on account of increased expense due largely to new legislation recently put in force, one feature of which is a change of basis of taxation causing an increase in our taxes amounting to about 120 per cent.'

"About a week after putting those rates into effect, the City of Manitowoc secured an injunction restraining the company from charging more than 10 cents for a ride between Manitowoc and Two Rivers, and the case has been in the courts up to June 4, when the injunction was dissolved and the case dismissed. Now notice is hereby given that the rates put in force at that time as above set forth will be reinstated on June 15 next."

Recommendations Regarding Service in Watertown

The Public Service Commission of the Second District of New York has sent a communication to the Black River Traction Company, Watertown, N. Y., in regard to service on the lines of the company. The commission is of the opinion that Watertown has outgrown the existing street railway facilities; that the city is entitled to more extensive service over territory not now covered by existing tracks, and that additional service could be provided upon the present lines of the company. The commission asks whether the company has under consideration any plans for the extension of its service, and calls attention to the fact that there are no directors of the company who are residents of Watertown. It suggests that the management of the company be put in more direct touch with the needs and requirements of the city by the election of a suitable number of directors residing in the city who are interested in the company's welfare. The company is reminded of its promise to extend its present terminus to a point nearly opposite the works of the New York Air Brake Company, provided the necessary local franchises and local consents can be obtained, and directs that immediate application for such franchise be made to the city authorities. The commission also asks for assurance regarding the reconstruction of the track on State Street. Open cars should be provided during the summer months. This would add to the convenience and comfort of the patrons and enhance the revenues of the company. The company is requested to state whether it will not continue on its own motion to place open cars in service.

Meeting of the Central Electric Traffic Association.—The regular monthly meeting of the Central Electric Traffic Association will be held at Dayton, Ohio, on July 19, 1910.

Cincinnati Union Depot Ordinance Passed.—On June 27, 1910, the City Council of Cincinnati passed an ordinance giving the Union Depot & Terminal Company permission to build a depot and terminal for the railroads and electric railways which enter Cincinnati. John E. Bleekman is largely interested in the new company.

Calgary P.-A.-Y.-E. Notices.—The Calgary Street Railway, Calgary, Alta., Can., has posted notices in its pay-as-you-enter cars to the effect that "Passengers are required to voluntarily place fares in the box. Neglect to pay is a criminal offense, subject to a fine or imprisonment." The Calgary system belongs to the city.

Improved Service on the Winona Interurban Railway.—The Winona Interurban Railway, Winona Lake, Ind., plans to adopt a five-hour passenger schedule between Goshen and Indianapolis by way of Milford, Warsaw, Peru and Kokomo. The freight and express service will also be improved, and live stock and carload lots of grain, wood, tile, etc., will be handled.

Excursion of Train Dispatchers' Association of America.—The Spokane & Inland Empire Railroad, Spokane, Wash., and the Cœur d'Alene & St. Joe Transportation Company on June 22, 1910, conducted a trolley outing to Liberty Lake and Cœur d'Alene Lake and a steamer trip on Lake Cœur d'Alene for the members of the Train Dispatchers' Association of America, who were in session at Spokane.

Another Trade Excursion in Indiana.—The Indianapolis Trade Association has planned a second trip in Indiana in the interest of the trades people of Indianapolis. July 15, 1910, has been set as the date for this excursion. The route will include 14 towns on the line of the Indianapolis & Cincinnati Traction Company and the Chicago, Cincinnati, Cleveland & St. Louis Railway between Indianapolis, Rushville and Shelbyville.

Hearing on Commutation Rates Before the Interstate Commission.—The Interstate Commerce Commission has ordered a hearing in Washington on July 12, 1910, on the recent advances in commutation rates announced by the New York Central & Hudson River Railroad, New York, New Haven & Hartford Railroad, Erie Railroad, Central Railroad of New Jersey, Philadelphia & Reading Railroad, Pennsylvania Railroad, Lehigh Valley Railroad and the Delaware, Lackawanna & Western Railroad.

Meetings of Seattle Employees to Consider Prevention of Accidents.—The first meeting of officers of the operating and claim departments of the Seattle (Wash.) Electric Company, and trainmen of the company, planned for the campaign of education to prevent accidents, was held at the Fremont barn on June 21, 1910. A. L. Kempster, superintendent of transportation; Geo. Carson, C. M. Carter, J. M. Wilmot, C. F. Young and Gustave Newberg, of the claim department; G. A. Richardson, assistant superintendent of transportation, and J. E. Allison, superintendent of employment, all addressed the meeting.

Arbitration in Connecticut.—The sessions of the board of arbitrators which is to consider the questions of wages and terms of service of the employees of the Connecticut Company are to be held in the County Court House at New Haven. They will be begun on July 9, 1910, at 10 a. m., and will be open to the public. The men will present their case first. As previously stated, the members of the board of arbitration are Clarence Deming, David E. Fitzgerald and Judge William S. Case of the Superior Court. Mr. Deming was selected by the company, Mr. Fitzgerald by the men, and Judge Case by Mr. Deming and Mr. Fitzgerald.

Complaint by Electric Railway Against Steam Railroad Sustained.—In the complaint brought by the Wilkes-Barre & Hazleton Railway, Wilkes-Barre, Pa., against the Lehigh Valley Railroad regarding rates on coal the commission is of the opinion that "the rate of 40 cents per ton on anthracite buckwheat coal from Jeddo No. 4 Colliery via the Ebervale branch to the Wilkes-Barre & Hazleton Railway Junction, a distance of 5.9 miles, as compared with the rate of 30 cents per ton from the same originating point on the same commodity to Hazleton via Lumber Yard, a distance of 8.7 miles, is unreasonable." The commission therefore recommends that the Lehigh Valley Railroad shall not hereafter charge a higher rate from Jeddo No. 4 Colliery to the Wilkes-Barre & Hazleton Railway Junction than is charged from the same colliery on the same commodity to Hazleton.

Wages and Terms of Service in Toronto.—After considering the questions of terms of service and pay since May 16, 1910, the representatives of the employees of the Toronto (Ont.) Railway and the officers of the company are unable to agree, and it is probable that the differences will be submitted to the conciliation board under the Lemieux Act. The company is willing to renew the present agreement for three years. If any changes are made, however, it insists that there shall be no badges for union men; that there shall be a reduction in the hours of pay on Sunday; that there shall be no guarantee of a 12-hour day; that one more new uniform shall be purchased by new men, and that if the matter goes to the conciliation board the advisability shall be considered of reducing the pay of the employees to the scale in force in Montreal, which is 20 cents an hour to first-year men and 21 cents an hour thereafter. The employees of the Toronto Railway demand 25 cents an hour for first-year men and 28 cents an hour thereafter.

Increase in Wages on Third Avenue Railroad, New York.—On June 29, 1910, F. W. Whitridge, receiver of the Third Avenue Railroad, addressed the following communication to the employees of the Third Avenue system, New York, N. Y., including the Third Avenue Railroad, Union Railway, Dry Dock, East Broadway & Battery Railroad, and the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway: "The year ended June 30, 1910, has been a prosperous one for this road, and its earnings have exceeded my anticipations. This result is due in part to the diligence and courtesy of the employees of the road, and I am happy to be able to recognize their share in producing the prosperity of the company by raising the wages of the motormen and conductors 2 cents per hour, after July 1, 1910. I believe the men of the Third Avenue system—when the advantages of the benefit and insurance association are considered—are by this increase in pay, put in a better position than any other men engaged in the same business."

Third Arbitrator Selected in Massachusetts.—E. C. Foster and W. P. Hayes, members of the board of arbitration selected to decide the question of wages of the employees of the New England Investment & Security Company, have chosen Charles S. Hamlin, a Boston lawyer, as the third member of the tribunal. A preliminary meeting was arranged to be held in Mr. Hamlin's offices in Boston, on July 5, 1910, at which plans were to be made for continuing the conferences. Mr. Hamlin was graduated from Harvard in 1883, and later studied at the Harvard Law School and at Washington and Lee University. He served as Assistant Secretary of the Treasury under President Cleveland and represented the United States at the Japanese conference in 1897 and in the fur seal fishery cases with Great Britain in the same year. In 1905 he was a member of the executive committee of the Civic Federation of New England. The arbitrators are to meet daily except on Sundays, until all the evidence has been presented and the finding reached. The finding of the board is to be effective from June 1, 1910, to June 1, 1911, and both the company and the men are to be bound to the terms imposed by the arbitrators.

Wages Fixed in Yonkers.—Justice Keogh, of the Supreme Court, to whom the settlement of the question of the wages of the employees of the Yonkers (N. Y.) Railroad was referred, has decided that the pay of one-year men should be increased to 23 cents an hour, and the pay of all men who have worked longer than a year should be increased to 26 cents an hour. Justice Keogh, in his decision, said: "The intelligent and candid statement submitted by the receiver has been of great assistance to me in the investigation which I have made. I will increase the pay of one-year men to 23 cents an hour, and I will increase the pay of all the men who have worked longer than one year to 26 cents an hour. I am adopting the sliding scale of compensation because I found it in force on the Yonkers Railroad. I have had neither the time nor the evidence to decide between the relative merits of the flat rate and the sliding scale rate of compensation. I will sign an order accordingly." The men demanded a flat rate of wages of 30 cents an hour. The course pursued by Leslie Sutherland, receiver of the company, following the strike, and the reasons for the submission of the matter to Judge Keogh for settlement were referred to in the Electric Railway Journal of July 2, 1910, page 50. Judge Keogh subsequently made the order applicable to the employees of the Westchester Electric Railroad.

Personal Mention

Mr. Walter L. Weston has been elected president of the Tampa-Sulphur Springs Traction Company, Tampa, Fla., to succeed Mr. A. R. Swann.

Mr. Peter O. Knight has been elected vice-president of the Tampa-Sulphur Springs Traction Company, Tampa, Fla., to succeed Mr. L. Brill.

Mr. L. E. Woodward has been elected treasurer of the Gary & Interurban Railway, Gary, Ind., to succeed Mr. C. W. Chase, formerly secretary and treasurer of the company, who retains the office of secretary.

Mr. H. S. Cooper, retiring general manager of the Galveston (Tex.) Electric Company, was summoned to the car house of the company recently at midnight and presented with a gold watch and fob as a token of esteem.

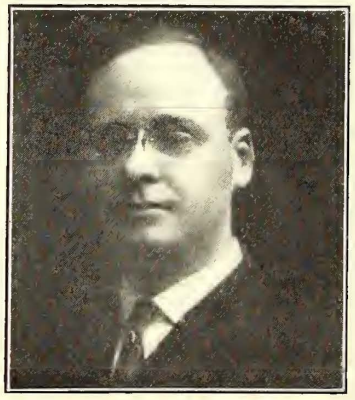
Mr. S. E. Simmons has been appointed superintendent of transportation of the Georgia Railway & Electric Company, Atlanta, Ga., to succeed Mr. H. N. Hurt, resigned. Mr. Simmons was formerly assistant superintendent of transportation of the company.

Mr. C. M. Witt has been appointed auditor of the Indianapolis, New Castle & Toledo Railway, Indianapolis, Ind. Mr. Witt was formerly connected with the Indiana Union Traction Company, Anderson, Ind., which he served for the last five years in the mechanical and auditing departments.

Mr. M. J. Kehoe, superintendent of power in charge of operation of the main plant of the Fort Wayne & Wabash Valley Traction Company, Fort Wayne, Ind., has also been appointed superintendent of the light and power department of the company which does the commercial lighting in Fort Wayne.

Mr. C. G. Goodrich, president of the Twin City Rapid Transit Company, Minneapolis, Minn., and Mr. G. G. Moore, one of the receivers of the Chicago & Milwaukee Electric Railroad, Highwood, Ill., have been retained by Judge Grosscup as advisor to assist him in passing on the claims of the holders of the securities of the Cicero & Proviso Street Railway, Chicago, Ill., that the plan for the reorganization of the Chicago Consolidated Traction Company does not offer them a fair settlement. The first meeting to consider the claims of those interested in the Cicero & Proviso Street Railway will be held in Chicago on July 12, 1910.

Mr. W. I. Sturtevant, manager of the Everett Railway, Light & Water Company, Everett, Wash., has recently been appointed manager of the Seattle-Everett Traction Company. Mr. Sturtevant was graduated from the Massachusetts Institute of Technology with the degree of electrical engineer in 1901. He immediately entered the Boston office of Stone & Webster. Soon thereafter he was transferred to the Seattle (Wash.) Electric Company, with which he filled various positions for about three years, when he was transferred to the Paducah Light & Power Company, Paducah, Ky., as general superintendent in charge of the railway, lighting, steam heat and gas departments. Mr. Sturtevant remained in Paducah about 18 months, and was then appointed superintendent of the Pensacola (Fla.) Electric Company, also controlled by Stone & Webster. In 1907 Mr. Sturtevant was appointed manager of the Everett Railway, Light & Water Company, Everett, Wash., in charge of the railway, lighting and water systems of Everett. In addition to the duties of his office as manager of the Everett Railway, Light & Water Company, Mr. Sturtevant will also act as manager of the Seattle-Everett Traction Company, which operates a high-speed interurban electric railway between Everett and Seattle.



W. I. Sturtevant

Mr. W. A. Carson, general manager of the Evansville (Ind.) Railways, who was also recently appointed general manager of the Owensboro (Ky.) City Railroad and the Henderson (Ky.) Traction Company, was born on October 4, 1881, on a farm in Shelby County, Indiana. Mr. Carson's parents moved to Indianapolis when he was seven years old, and he was educated in the schools of that city, and was graduated from the Indianapolis Manual Training School in 1901. Mr. Carson immediately took a clerical position in the office of the National Automobile Company, where he remained more than two years. In December, 1903, Mr. Carson became associated with the Indianapolis & Cincinnati Traction Company, Indianapolis, Ind., as chief clerk to Mr. A. A. Anderson, general superintendent of the company in charge of operation and construction. This company was then operating 28 miles from Indianapolis to Shelbyville and constructing 40 miles of single-phase line from Indianapolis to Shelbyville. During Mr. Carson's connection with the company the Shelbyville line was extended 22 miles to Greensburg and changed from 600-volt d.c. to 3300-volt a.c., and the Rushville line was extended 16 miles to Connersville, completing a system of 107 miles. Mr. Anderson resigned from the Indianapolis & Cincinnati Traction Company in October, 1906, to become general manager of the Indianapolis, Columbus & Southern Traction Company and the Indianapolis & Louisville Traction Company, and Mr. Carson accepted the position of assistant general manager of the Indianapolis, Columbus & Southern Traction Company. In October, 1907, an extension of the Indianapolis, Columbus & Southern Traction Company's lines from Columbus to Seymour was placed in operation, and the same month the Indianapolis & Louisville Traction Company opened its line between Sellersburg and Seymour, completing the line between Indianapolis and Louisville, 117 miles, and through limited service was inaugurated. Mr. Carson remained in the capacity of assistant general manager of the Indianapolis, Columbus & Southern Traction Company until July, 1908, when he was appointed general manager of the Evansville Railways, which position he still retains. A syndicate composed of men interested in the Evansville Railways recently took over the Owensboro City Railroad and the Henderson Traction Company, and Mr. Carson was appointed general manager of both properties.

The Boston (Mass.) Elevated Railway has for several years published a descriptive folder of its system for the benefit of visitors interested in its engineering and operating details. A new edition has recently been brought out, showing the latest additions to the rapid transit system, including the Forest Hills elevated extension, and the extensions now under way toward Malden, Everett and East Cambridge. The subway now being built by the company in the city of Cambridge is also shown, together with the subway authorized by law under the south embankment of the Charles River in Boston. The folder consists of a single sheet, which folds into six 4½ x 9-in. pages, the first page giving a map of the rapid transit system, exclusive of surface lines, and illustrating in comprehensive form the inter-relations of subways, tunnels and elevated lines.

The interior of the folder is devoted to a pithy outline of the engineering features of the elevated structure, Washington Street and East Boston tunnels, Tremont Street subway, and extensions mentioned above, including dates upon which different sections of the rapid transit system were opened for traffic, ownership, terms of leases, and distances. This is followed by a description of the elevated division, covering its organization, routes of trains, operation of transfer and ticket systems, rates of wages paid to employees, distances on the elevated system, curves and grades, details of track construction, signal system, drawbridge, repair shops, and car equipment details. A list of the number and character of elevated cars is given in the folder, including construction, tool and wrecking cars used on the overhead and tunnel lines. The company owns two electric locomotives which are used in shifting cars in its yards, and in miscellaneous car and material transportation. The folder has been warmly received by technical men visiting the elevated system, and also has proved advantageous in giving employees a summarized sketch of the more important features of the road.

Construction News

Construction News Notes are classified under each heading alphabetically by States.

An asterisk (*) indicates a project not previously reported.

RECENT INCORPORATIONS

***Hanford & Summit Lake Railway, Hanford, Cal.**—Application for a charter has been filed in California by this company to build an electric railway through Grangeville and Hardwick, into the Summit Lake region, and to return through Lemoore and Armona. The railway, including an extension to Laton, will be 15 miles long. Capital stock, $15,000. Incorporators: Charles R. Harwick, J. O. Hickman, Geo. C. Ayedelott, Hanford; Ralph W. Heins, Santa Cruz, and Clifford McClellan, San Francisco.

***Alton & Southern Railroad, East St. Louis, Ill.**—Incorporated in Illinois to build an electric railway from the right of way of the Southern Railway, in East St. Louis, to the right of way of the St. Louis & Belleville Electric Railway, near Louisiana Boulevard. Principal office, East St. Louis. Capital stock, $10,000. Incorporators: Arthur V. Davis, R. B. Mellon, Pittsburgh, Pa.; Charles M. Hall, Niagara Falls, N. Y.; C. B. Fox, Filbert McCulloch, Charles Souder and W. H. Hebenstreit, East St. Louis, Ill.

***Cincinnati, Lexington & Licking Valley Railroad, Frankfort, Ky.**—Incorporated in Kentucky to build an electric railway through Fayette, Pendleton, Kenton and Campbell Counties, connecting Lexington and Newport. Capital stock, $30,000. Officers: Don G. McVean, Covington, Ky.; R. W. Day, Scranton, Pa.; F. L. Fuller, New York; T. J. Foster and W. L. Connell, Scranton, Pa.; R. H. Reese and Wade H. Lain, Cynthiana, Ky.

***Croft Railroad, Alexander, W. Va.**—Chartered in West Virginia to build a railroad to be operated by steam or electricity from a point near Alexander to Zenders Farm. Capital stock, $8,000. Incorporators: J. H. Henderson, J. L. Kendall, S. A. Kendall and Milton J. Henderson, Pittsburgh; J. Gibson McIlvain, Hugh McIlvain and W. B. McIlvain, Philadelphia.

FRANCHISES

Hot Springs, Ark.—The Little Rock & Hot Springs Electric Railway, Little Rock, has asked the City Council for a franchise for an extension of its line in South Hot Springs.

Glendale, Cal.—E. D. Goode, representing the Glendale & Eagle Rock Railway, Los Angeles, has been granted a franchise to build an extension to the northern city limits of Glendale. [E. R. J., June 18, '10.]

Columbia City, Ind.—The Ft. Wayne & Winona Traction Company, Ft. Wayne, has been granted a franchise to build a railway in Columbia City. This is part of a plan to build a proposed 40-mile interurban railway to connect Ft. Wayne, Arcola, Coesse, Columbia City, Larwell, Pierceton, Wooster, Winona and Warsaw. J. A. Barry, Ft. Wayne, is interested. [E. R. J., June 25, '10.]

Ft. Wayne, Ind.—The Ft. Wayne & Winona Traction Company, Ft. Wayne, has been granted a franchise by the Commissioners of Allen County to build a railway through Allen County, provided the company completes its projected line by January, 1910. This is part of a plan to connect Ft. Wayne, Arcola, Coesse, Columbia City, Larwell, Princeton, Wooster, Winona and Warsaw. J. A. Barry and E. T. Hoffman are interested. [E. R. J., June 25, '10.]

Lansing, Mich.—The Michigan United Railway, Lansing, is planning to secure a franchise from the City Council to build a loop on Ottawa Street and Grand Avenue.

***Schenectady, N. Y.**—Messrs. Angle & Strong, Schenectady, have asked the Common Council for a franchise to build a double-track line into Erie, along East Twelfth Street to State Street.

Fostoria, Ohio.—J. D. McDonel, representing the Fostoria & Fremont Electric Railway, has filed an application with the Seneca County Commissioners asking for a 25-year franchise to build a railway across the public highways. This is part of a plan to build a 21-mile electric railway from Fostoria to Fremont, via Havens, Burgoon, Kansas and Amsden. J. D. McDonel, secretary. [E. R. J., Dec. 25, '09.]

Chattanooga, Tenn.—D. J. Duncan and associates have been granted a franchise by the Board of Aldermen to build a new street railway in Chattanooga. This is part of a plan to build a line over the main valley road from Hamilton County Court line to Rhea Springs. [E. R. J., Jan. 29, '10.]

***Austin, Tex.**—C. V. Burkhead, San Antonio, and associates, have been granted a franchise by the City Council to build a street railway in South Austin.

***Spokane, Wash.**—The Washington Water Company have been granted a franchise to build a railway on Cannon Hill to connect with its other lines.

TRACK AND ROADWAY

Helena Street & Interurban Railroad, Helena, Ark.—This company has extended its lines four miles from Helena to West Helena.

Selma Street & Suburban Railway, Selma, Ala.—This company is said to be considering plans for the extension of its line from the northern part of Selma to Summerfield, a distance of 9 miles.

***Texarkana, Ark.**—W. J. Wood, Jr., is said to be interested in promoting an electric railway to connect Texarkana and Hot Springs, via Hope.

British Columbia Electric Railway, Ltd., Vancouver, B. C.—This company will extend its lines to Millside in the near future and work on the Lulu Island section will be started soon.

Monterey & Del Monto Heights Electric Railway, Monterey, Cal.—This company has completed the preliminary arrangements and construction has been started on its projected 4-mile railway to connect Monterey and Del Monte Heights. F. M. Fairchild, 1707½ Oak Street, San Francisco, general manager. [E. R. J., July 24, '09.]

Oakland (Cal.) Traction Company.—This company is building a double-track line and installing sidings along the right of way leading to Leona Heights.

Pacific Electric Railway, Los Angeles, Cal.—This company has opened its Wilmington-Long Beach branch to passenger traffic. It has also completed another 12-mile section toward Riverside. The company is said to be considering plans to build a railway between the Cahuenga Valley and the San Fernando Valley, over the Cahuenga Pass.

San Diego, El Cajon & Escondido Railway, San Diego, Cal.—This company is reported to have started grading preliminary to the construction of its proposed 65-mile electric railway to connect San Diego, La Mesa, El Cajon, Bostonia, Lakeside, Morton, San Pasquel, Bernardo and Escondido. It is expected to have the line completed within a year. G. W. Pursell, San Diego, general manager. [E. R. J., Nov. 2, '09.]

Bridgeport & Danbury Electric Railway, Bridgeport, Conn.—The Supreme Court has granted this company permission to build a railway between Bridgeport and Danbury. It will also connect Stepney, Monroe, Botsford, Hattertown, Newtown, Dodgingtown and with the lines of the Danbury & Bethel Street Railway, Danbury. Morton Plant, New London, Conn., is interested. [E. R. J., June 11, '10.]

Connecticut Company, Bridgeport, Conn.—This company has awarded the contract for construction of the extension of the Barnum Avenue line from Bridgeport to Stratford to Bryan F. Mahan, New London.

Georgia Railway & Electric Company, Atlanta, Ga.—This company has begun rehabilitating its line from East Lake Junction to Decatur, so that through cars will be run from Atlanta to Decatur.

Fairburn & Atlanta Railway, Fairburn, Ga.—Grading has been completed by this company on its 20-mile line between Atlanta and Fairburn, with the exception of a 1-mile stretch in Fulton and De Kalb Counties. Track-laying will begin at once. The company is said to be considering the advisability of installing Edison storage battery cars. W. T. Roberts, Fairburn, president. [E. R. J., Oct. 2, '09.]

Egyptian Traction Company, Eldorado, Ill.—This company has nearly completed preliminary arrangements, capital has been obtained and construction will soon start on its proposed 100-mile railway from Mt. Vernon, Ind., to Murphysboro, Ill. T. E. K. Hixon, Eldorado, general manager. [E. R. J., June 25, '10.]

Waukegan, Rockford & Elgin Traction Company, Palatine, Ill.—This company, it is said, will start construction as soon as $100,000 in stock is subscribed for its proposed electric railway from Palatine to Lake Zurich and Wauconda, and ultimately to Volo Lake, Pistake Lake and Fox Lake. [E. R. J., Oct. 23, '09.]

Ft. Wayne & Winona Traction Company, Ft. Wayne, Ind.—This company, recently incorporated, advises that it will start construction as soon as deeds can be secured on its proposed 40-mile interurban electric railway to connect Arcola, Coesse, Columbia City, Wochester, Pierceton, Winona and Warsau. Officers: J. A. Barry, Ft. Wayne, president and treasurer; G. M. Leslie, vice-president, and Ralph Barry, secretary. [E. R. J., June 25, '10.]

Muncie & Portland Traction Company, Portland, Ind.—This company is said to be considering a plan to extend its line eastward from Portland to Celina, via Coldwater and Fort Recovery, Ohio.

Cedar Rapids & Iowa City Railway & Light Company, Cedar Rapids, Ia.—This company, it is said, will extend its line to Muscatine.

Iowa City (Ia.) Electric Railway.—This company advises that it will start work July 21 on its proposed 4-mile railway in Iowa City. Power will be purchased from the Iowa City Light Company, and it will operate six cars. Capital stock authorized, $100,000. Bonds authorized, $60,000. Officers: J. O. Schulze, president, general manager and purchasing agent; J. H. Rober, vice-president, and D. A. Reese, secretary and treasurer. [E. R. J., June 25, '10.]

Haverhill & Amesbury Street Railway, Merrimac, Mass.—This company has nearly completed the work of rebuilding its railway between Haverhill, Merrimac and Amesbury.

Detroit, Lansing & Grand Rapids Railway, Detroit, Mich.—This company has surveyed between Lansing and Detroit, and has now started surveys from Brighton to Detroit, on its proposed 150-mile railway between Detroit and Grand Rapids. It is expected to start work this fall. [E R. J., June 18, '10.]

***Nixa, Mo.**—H. M. Wilson and W. H. Schrieber are said to be promoting an electric railway to connect Nixa and Springfield.

Westchester Northern Railroad, White Plains, N. Y.—This company has been authorized by the Public Service Commission, Second District, to issue $60,000 par value common capital stock. The proceeds are to be used for the acquisition of right of way of the company's line. This company is one of the subsidiary companies of the New York, New Haven & Hartford Railroad, and was recently authorized by the commission to construct its line in Westchester. The line also extends into Connecticut. [E. R. J., June 4, '10.]

Ohio Electric Railway, Cincinnati, Ohio.—This company reports that it expects to build new track between Williamsburg and Hamilton, which will make the line from Dayton to Hamilton standard construction, above high water, and will enable the operation of heavy equipment.

Central Ohio Promoting Company, Columbus, Ohio.—This company is engaged in securing rights of way for its proposed 60-mile railway to connect Columbus and Zanesville. James L. Holden, Columbus, president. [E. R. J., June 4, '10.]

Hocking-Sunday Creek Traction Company, Nelsonville, Ohio.—This company has recently completed three miles of track from Nelsonville, and expects to build to Athens, a distance of 13 miles, this summer.

Johnstown (Pa.) Traction Company.—It is stated that this company proposes to extend its main line to New Hope, with a branch to the bridge at Washington's Crossing.

South Dakota Interurban Railway, Centerville, S. D.—This company, which expects to build an interurban railway from Parkston to Bijou Hills, Chamberlain and Sioux City, has recently perfected its organization by electing the following officers: W. E. Miller, Bijou Hills, president; A. F. Grimm, Parkston, vice-president; F. E. Graves, Bijou Hills, secretary, and R. W. Thwing, treasurer. [E. R. J., Feb. 19, '10.]

Virginia Railway & Power Company, Richmond, Va.—This company has been asked by the citizens from Prince George and Surry Counties to extend its lines from the present terminal at Petersburg to Norfolk.

Roanoke Street Railway & Electric Company, Roanoke, Va.—This company has awarded the contract to Messrs. Huggins & Bates for the survey of its entire system.

Graham (Va.) Electric Railway.—James F. Dudley, president of this company, which was recently chartered to build a 2-mile railway from East Graham to West Graham, writes that the company is now completing preliminary arrangements, and it is expected that it will soon receive its franchise. [E. R. J., June 25, '10.]

Clarksburg & Weston Electric Railway, Clarksburg, W. Va.—Work has been started by this company on the first seven-mile section of its proposed 24-miles railway to connect Clarksburg and Weston. The company is said to have purchased three bridges across the Ohio River, from the Baltimore & Ohio Railroad. James O. Watson, Fairmont, general manager. [E. R. J., June 11, '10.]

Elkins (W. Va.) Electric Railway.—This company reports it will build 7 or 8 miles of track during the next three months. P. B. Bloomfield, general manager.

Middle Island Railroad, Middlebourne, W. Va.—This company, recently incorporated, advises that it is making surveys and that construction will be started in the near future on its proposed 60-mile railway to connect Sistersville, Kidwell, Middlebourne, Shirley and Clarksburg. It will furnish power for lighting. Bonds authorized, $450,000. Officers: T. Moore Jackson, Clarksburg, president; I. M. Underwood, Middlebourne, vice-president; John F. Shore, Middlebourne, secretary and treasurer. [E. R. J., April 9, '10.]

SHOPS AND BUILDINGS

Chicago, Ottawa & Peoria Railway, Ottawa, Ill.—This company will build a car repair shop 60 ft. x 300 ft., enclosing three tracks and an equipment of car-repair tools. The structure will be built of brick and steel, and will be similar in design to the Decatur shop buildings of the Illinois Traction System.

Union Street Railway, New Bedford, Mass.—This company has awarded the contract to H. P. Converse & Company, Boston, for building its new car house at New Bedford. Estimated cost is $156,000. Louis E. Dectremps, New Bedford, architect.

Worcester (Mass.) Consolidated Street Railway.—This company has prepared plans for a large addition to the Gates Lane car house in Worcester.

POWER HOUSES AND SUBSTATIONS

British Columbia Electric Railway, Vancouver, B. C.—This company will soon start work upon its new power plant in the Chilliwack district, northeast of the Popkum Indian reserve. The site of the proposed plant is a 100-acre tract. Power to be derived from Jones Lake, 18 miles east of Chilliwack, and Chilliwack Lake, 23 miles southeast of Chilliwack. The tunnel from Jones Lake is to be 10,200 ft. long. The tunnel from Chilliwack Lake is to be 14 by 16 ft. in size and 5¼ miles long.

Ohio Electric Railway, Cincinnati, Ohio.—This company states it expects to build three new substations between Dayton and Richmond and Dayton and Union City and connect them with transmission line so as to furnish power from the Lindenwald power plant. It has purchased six substation equipments from Westinghouse Electric & Manufacturing Company for the Dayton and Richmond and Dayton and Union City divisions. F. A. Healy, secretary.

Richmond & Henrico Railway, Richmond, Va.—This company has awarded the contract to the Babcock & Wilcox Company for forged steel boilers for its new power house to be erected on Louisiana Street, in Fulton. Estimated cost is $10,000.

Twin City Light & Traction Company, Centralia, Wash.—This company, it is said, has let the contract for building a power plant to be located 4 miles southeast of Centralia on Coal Creek. Estimated cost of plant is $150,000.

Elkins (W. Va.) Electric Railway.—This company will build a new power station this summer. P. B. Bloomfield, general manager.

Manufactures & Supplies

ROLLING STOCK

Calgary (Alta.) Street Railway is said to be planning to purchase 12 new cars.

Brooklyn (N. Y.) Rapid Transit Company is understood to be in the market for new snow-fighting equipment.

Portland, Eugene & Eastern Railway, Portland, Ore., is said to be considering the purchase of several additional cars.

Oregon Electric Railway, Portland, Ore., has ordered one electric locomotive from the American Locomotive Company.

San José & Santa Clara Railroad, San José, Cal., is planning to buy several broad-gage cars and other new equipment.

Los Angeles & Redondo Railway, Los Angeles, Cal., is building 10 passenger cars and 20 additional freight cars at its shops in Redondo.

Iowa City (Ia.) Electric Railway, which expects to begin work shortly on a 4-mile street railway in Iowa City, is considering the purchase of six cars.

Charles City Western Railway, Charles City, Ia., which is building a 20-mile line from Charles City, has purchased one 55-ft. gasoline motor car from the McKeen Motor Car Company.

Woodstock & Sycamore Traction Company, Sycamore, Ill., has purchased one 55-ft. gasoline motor car from the McKeen Motor Car Company, for use on its line, which is now being built between Woodstock and Sycamore. Additional cars of this type will be put in service on this line when track laying is completed.

Havana (Cuba) Central Railroad, noted in the ELECTRIC RAILWAY JOURNAL of Feb. 26, 1910, as having placed an order with The J. G. Brill Company for 10 semi-convertible cars, has specified the following details for these cars:

Length of body.....28 ft.	Fenders or wheelguards.H. B.
Over bumpers.....38 ft.	Gongs.....Brill Dedenda
Width over sills..7 ft. 11½ in.	Hand brakes.....Brill
Over posts at belt.8 ft. 2 in.	Motors, type and number,
Body .....wood	GE-67
Interior trim.....mahogany	Registers .....International
Underframe .....composite	Sanders.....Brill Dumpit
Bumpers.....Brill angle iron	Seats.....Hale & Kilburn
Couplers .....Brill-Hovey	Trolley base.....Union
Curtain fixtures.....Forsyth	Trucks, type.
Curtain material....pantasote	Brill No. 27-GE 1

TRADE NOTES

I. R. Nelson & Company, Newark, N. J., have moved their headquarters to 85 Columbia Street, Newark, N. J.

McKeen Motor Car Company, Omaha, Neb., has delivered two 70-ft. gasoline motor cars to the Chicago, Rock Island & Pacific Railroad.

Crocker-Wheeler Company, Ampere, N. J., has filed an amended certificate of incorporation increasing its capital stock from $2,000,000 to $5,000,000.

Massachusetts Chemical Company, Walpole, Mass., is enlarging its plant at Walpole by the addition of buildings which will have two and a half acres of floor space.

Asbestos Protected Metal Company, Canton, Mass., has opened an office at 100 Broadway, New York, N. Y. P. M. Stewart, formerly building commissioner, is resident manager.

L. R. Pomeroy, assistant to the president of the Safety Car & Lighting Company, New York, N. Y., has resigned to become connected with J. G. White & Company, Inc., New York, N. Y., as chief engineer of their railway and industrial division.

United States Electric Company, New York, N. Y., announces that it has secured the services of W. E. Harkness, who has been identified for a number of years with the Western Electric Company, New York, N. Y., in the development of train dispatching. Mr. Harkness will devote his entire attention to telephone, telegraph and selector equipment.

Indian Refining Company, Cincinnati, Ohio, has secured for its railway lubrication department the services of Isaac B. Connor, formerly with the Galena Signal Oil Company, and Adolph J. Varrelmann, formerly connected with the Pay-As-You-Enter Car Corporation. Mr. Varrelmann will have his headquarters at 30 Church Street, New York, N. Y.

St. Louis Steel Foundry, St. Louis, Mo., which is owned and operated by the Curtis & Company Manufacturing Company, has recently completed an extensive addition to its steel plant in St. Louis. The new apparatus installed includes additional crane and grinding equipment. By the addition of this extension the floor space of the plant has been increased nearly 100 per cent.

S. K. Elliott Electric Company, Cleveland, Ohio, on July 1 discontinued the sale of Westinghouse generators, motors, etc., and has taken up the sale of apparatus manufactured by the Fort Wayne Electric Works, Fort Wayne, Ind. The line of apparatus manufactured by the Fort Wayne Works covers all sizes of a.c. and d.c. generators, motors, switchboards, transformers, etc.

George E. Austin Company, New York, N. Y., has been appointed export representative for the following manufacturers: Cleveland Rubber Works of the Mechanical Rubber Company, Eureka Tempered Copper Works, Samson Cordage Works, American General Engineering Company, Imperial Rubber Company, Massachusetts Chemical Company, Macomber-Whyte-Moon Company and A. W. Chesterton & Company.

Lord Manufacturing Company, Lord Electric Company and Lord Construction Company, New York, N. Y., are taking contracts for lighting installations for amusement parks, railway shops and factories. In these contracts the companies are supplying their Luminator flaming arc lamp, which gives a very brilliant light, and when hung at a sufficient height above the ground makes an even, pleasing glow. The ability of these companies to take contracts of this kind and to supply and install equipment complete has proven of interest to many large operators.

Edgar Allen American Manganese Steel Company, Chicago, Ill., has purchased the Chicago Heights plant of the American Brake Shoe & Foundry Company, devoted to the manufacture of manganese steel castings. The Edgar Allen American Manganese Steel Company has a similar plant at New Castle, Del. The Chicago Heights plant employs 500 men, and extensions under consideration will more than double the force. Stockholders of the American Brake Shoe & Foundry Company are represented in the directorate of the new company and in the personnel of its officers. Edgar Allen & Company, Ltd., Chicago, Ill., and Sheffield, England, have also become identified with the corporation. The Edgar Allen American Manganese Company was incorporated in Maine, with an authorized capital of $3,000,000. The company's Chicago office is in the McCormick Building, 193 Michigan Avenue. The directors are: R. Ortmann, president; J. B. Terbell, J. C. Ward, Otis H. Cutler, Joseph C. Gallagher. J. C. Ward is also a director of Edgar Allen & Company, Ltd., Sheffield, England, and is general manager of its American business.

Allis-Chalmers Company, Milwaukee, Wis., has elected David Van Alstyne vice-president in charge of manufacture, with headquarters at Milwaukee. Mr. Van Alstyne was born in Louisville, Ky., on June 14, 1865, and was graduated from the Massachusetts Institute of Technology in 1886. He became a machinists' apprentice on the Louisville & Nashville Railroad, and was connected with that railroad for eight years, during which time he served in various capacities. For three and a half years he was engaged in the foundry business in Louisville, after which he was for one year master mechanic on the Louisville, Henderson & St. Louis Railroad. In 1899 Mr. Van Alstyne entered the service of the Chicago Great Western Railroad as a division master mechanic, but was shortly afterward made superintendent of motive power, remaining in that position until May, 1904, when he accepted a position as mechanical superintendent on the Northern Pacific Railroad. In 1907 he was elected vice-president in charge of manufacture of the American Locomotive Company. During the past few months Mr. Van Alstyne has been retained in a consulting capacity for a Western railroad.

ADVERTISING LITERATURE

National Electrical Manufacturing Company, Elgin, Ill., has issued a folder describing and illustrating the National crossing signal for electric railways.

Edison Storage Battery Company, Orange, N. J., has issued a leaflet calling attention to the Edison storage battery for ignition and lighting purposes.

Joseph Dixon Crucible Company, Jersey City, N. J., has issued a 48-page catalog describing briefly many of the graphite products which it manufactures.

Chicago Concrete Machinery Company, Chicago, Ill., has issued a 40-page catalog illustrating and describing the various types of Chicago mixers which it manufactures.

Cairnduff Automatic Register Company, Syracuse, N. Y., has issued an illustrated folder which contains a comprehensive description of its automatic register step. The Cairnduff system is applicable to prepayment cars.

American Mason Safety Tread Company, Boston, Mass., has issued a booklet describing Karbolith flooring. In connection with the booklet, the company is mailing samples of the approximate shade of its No. 50 red Karbolith.

Uehling Instrument Company, Passaic, N. J., has published a series of pamphlets, among which is one devoted to a description of the Uehling gas composimeter, and another describing the Uehling pneumatic pyrometer.

General Electric Company, Schenectady, N. Y., describes in Bulletin 4739 the Mazda tungsten filament incandescent lamp, which gives three times as much light as a carbon filament lamp with the same consumption of energy.

Alexander Milburn Company, Baltimore, Md., has issued a 48-page catalog, in which are described and illustrated the various sizes of Milburn portable acetylene lights which it manufactures. This type of light is constructed to meet the demands for contractors, railways, tunnels, steam shovels, etc.

Electric Service Supplies Company, Philadelphia, Pa., in the "Keystone Traveler" for July discusses the merits of its "Pay-Within" type car. Many of the company's specialties are also described, among them the lock-on controller handle, Garton-Daniels lightning arrester, protected rail bond, the automotoneer, Keystone compound, International fare register, and the Lyon reinforced steel gear case.

Stone & Webster Engineering Corporation, Boston, Mass., has reprinted in booklet form an article entitled "The Wages of Faith," which appeared in the Stone & Webster *Public Service Journal* of October, 1909. The article contains deductions from correspondence with several engineers and employers of contractors regarding forms of construction contracts. The company has also published a booklet which contains a record of construction contracts completed or in progress during the second quarter of 1910, with classifications, locations and totals.

Ohio Brass Company, Mansfield, Ohio, calls attention to several features of its new No. 8 and "H" catalogs. The first contains a number of new and improved devices on electric line material, such as a rigid cross-over; small porcelain insulators; feeder wire splicer; mechanical feeder; wire strain clamp; track drill; bond compressor; two types of third-rail insulators; sander valve; sand trap; O-B electric car signal system, and Tomlinson couplers and accessories. Catalog "H," on steam specialties, lists a pressure regulating valve which is said to be meeting with great success; also gage cocks, water gages, and various lines of ordinary valves.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has reprinted in full Judge Cross' opinion filed in the United States Circuit Court, District of New Jersey, May 24, 1910, in the split motor frame case involving the Schmidt patent No. 609,977, in which the Westinghouse Electric & Manufacturing Company was complainant and the Allis-Chalmers Company defendant, and the order on the motion for a preliminary injunction filed on June 6, 1910, in the United States Circuit Court, Southern District of Ohio, Western Division, involving the Lange and Lamme patent No. 518,693, in which the Westinghouse Electric & Manufacturing Company was complainant and the Cincinnati, Milford & Loveland Traction Company defendant.