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During 1907 the Street Railway Journal printed and circulated 427,250 copies, an average of 8216 copies per week. Of this issue 10,000 copies are printed.

The Business Situation

The losses in gross business experienced by the steam railroad companies during the last two or three months as compared with the corresponding period of last year have not been paralleled by the electric railway companies. A few of the latter indeed have suffered considerably and many to a less extent. On the other hand, others have shown increases in gross business, indicating that the extent of passenger transportation is not so dependent upon the industrial situation as is the freight business of the steam railroads. While this is generally true, it is impossible to give an exact comparison of the earnings of the steam and electric railroads, as very few of the latter publish statistics of their monthly earnings, as is the practice of the steam railroad companies. Thus, the *Commercial and Financial Chronicle* last week quotes the January losses in gross earnings for 103 representative steam railroads, when compared with the gross earnings of January, 1907, at 12.9 per cent. The losses in net during the same period averaged 29.9 per cent. The corresponding figures for December were 6.45 per cent and 25.3 per cent. Figures on gross earnings of electric railways are published monthly in the STREET RAILWAY JOURNAL for from thirty to thirty-five companies, some large, some small. Conclusions derived from these figures would not necessarily hold as an average for the country, as the number is far too small a proportion of the entire industry. Nevertheless, the roads so reporting are quite widely distributed throughout the country and the figures on this account possess some significance. The table printed this week and that printed in the issue of March 7 show the monthly gross earnings for January of 29 companies. Of this number three show a decrease for the month, as compared with January, 1907, and 26 show an increase. The aggregate gross earnings for the 29 companies during January, 1907, was $4,629,765, or 5.3 per cent increase over that of January, 1907. The 14 roads which report figures for February have gross earnings of $3,107,147 and show a daily increase of 0.8 per cent. These figures take no consideration of difference in mileage, which is not a matter of record, but this was also excluded in the steam railroad figures where the increase in mileage was about 1 per cent. Undoubtedly this had a considerable influence in some instances, but probably not overpowering. The increases are fairly well distributed, as will be seen by an examination of the tables.

In the opinion of leading authorities on steam railroads the outlook in that business appears now to be brightening. F. K. Lane, Interstate Commerce Commissioner is even quoted this week as saying that next October there would be a shortage of steam railroad cars. There are indications also of an improved condition in the electric railway industry. Not only are orders being reported for supplies required for the maintenance of the different properties, but our columns during the last two or three weeks have contained statements of a number of important contracts covering large orders for equipment. This is reflected in the shops of such concerns as the General Electric Company and the Westinghouse Electric & Manufacturing Company, which report greater activity than one or two months ago and offer a very good index of the general status of the electrical industry.

The general situation also seems to be improving. A large number of buyers from retail houses are said to be in New York this spring. The principal metropolitan banks and trust companies which were forced to suspend in the

early part of the winter have succeeded in securing additional capital and have resumed operations. There has been a marked and seemingly well sustained advance in prices on the Stock Exchange compared with last fall. The United States Steel Company recently announced that the bookings for January were 25 per cent better than for December, that those for February were 25 per cent better than for January, and up to the middle of March the orders received were at least 25 per cent larger than those for February. The political situation also seems favorable. The latest presidential message recommends a change in the interstate commerce act and the anti-trust law, with the object of lessening some of their drastic features, although the suggested remedy of the exercise of federal discretion in the enforcement of these acts may not be generally approved. The late decisions of the Supreme Court in the matter of railroad rate laws in Minnesota and North Carolina should afford relief from enormous penalties and confiscatory laws when applied by the State governments.

Reviewing existing conditions broadly, therefore, and with no intention of taking too optimistic a view, the general situation seems improving and in this betterment the street railway companies should secure their full share.

The Value of Keeping Maintenance Records

The data given on another page of this issue in connection with the car defect record system of the Boston Elevated Railway Company clearly show the value of making a scientific study of operating points closely associated with the maintenance problem, and of extending the observations over a long period. Very small roads cannot be expected to give to these problems the same degree of attention in the way of record keeping as is practicable on a larger system, but memory is treacherous as a reliance and most companies will do well to maintain figures of the performance of their rolling stock in service. This, in fact, is one striking feature of the Boston system of maintenance records. It is so simple in plan that it is suitable alike to the road with a comparatively small amount and variety of equipment and that having many hundreds of cars, perhaps a thousand or more, in constant service. The need of an easily maintained yet straightforward record system is fundamental in either case.

It is a fair inference that the system in use in Boston has cut down the failures of cars on the streets in the last two or three years at least 50 per cent. Of course, the system itself has not alone done this good work, for the removal of trouble is quite another matter from its diagnosis. The records as made and interpreted, however, have given the company a detailed knowledge of the weak spots of its rolling stock, and by constant effort to reduce the definite troubles arising in the service, the results have been remarkably gratifying. The substitution of exact information regarding defects for general impressions, the location of specially troublesome sections of the system and the massing together of similar defects occurring at widely separated points have been of the greatest value in enabling the company to draw correct conclusions as to causes and remedies. Not the least wise part of this program is the clear definition of what should be classed as a defect, and it is not too much to say that without an arbitrary definition of the defect, capable of being applied at once to all cases of trouble on the cars by the inspector and the car house foreman, accurate conclusions would be almost impossible.

The cost of maintaining records of this nature is a small matter in proportion to the value of the deductions that are thus made possible. It is difficult to estimate the money saving represented by a reduction of car failures in service from 4258 in December, 1905, to 1698 in January, 1908, as they were in Boston. The actual reduction in shop expenses could probably be given a cash value. Such a figure, however, would not include the lessened inspection costs, nor would it take into consideration the advantage of generally safer operation and the less tangible financial gain due to a reduction of obstructions to the flow of travel. In these two latter improvements the public also benefits. In fact, the keeping of records of this character is plainly a policy which will broadly work out for the joint benefit of a company and its patrons.

Rolling Stock Maintenance and the Operating Department

On every street railway large enough to support a carefully organized maintenance department, that branch of the company's service is rightly held responsible for the condition of the rolling stock, but it is coming to be recognized more and more that the co-operation of the car service men, including inspectors of traffic as well as motormen, is a vital factor in reducing the cost of maintenance. The electrical and mechanical troubles caused by improper handling of cars on the streets are many, and it is just as important to prevent them as it is not to send the cars out upon the line in defective condition.

Careless handling of the brakes and improper feeding of the controller are the two main causes of trouble. There is nothing new in this, but it is a problem that never ends on a road where the personnel is in part at least frequently changing. The mechanical department is constantly face to face with the results of poor work at the controller handle and the brake valve, and aside from any question of increased power consumption, the need of more frequent shop overhauling is a certain sequence of improper operation. It is decidedly worth while for any company to expend a great deal of time and trouble to bring about better handling of its cars. It is surprising what can be done when a constant effort is made to exact a higher standard of work at the platform. We have known of cases where the closer study of the methods of car operation on the street, coupled with a careful following up of the failures in service, has greatly reduced the number of troubles occurring on the line, and decreased the shop service correspondingly. One of the best things that can be done on a road is for the different heads of departments in the maintenance and the car service staff to get together from time to time for informal discussions of the service conditions. On some roads it is a long distance from the master mechanic's office to the platform of the moving car, and unless the actual work of the motormen is constantly before the subordinate heads of the shop organization, there is no question that the latter will have more than the normal amount of work to do. With the im-

provements in equipment that are continually being made, it is a matter of constant interest to see how the car service men make use of new methods. Time spent on the cars in the inspection of the handling of the control and brakes is seldom wasted.

We mention this matter at this time because in the legitimate effort to reduce operating expenses which all well operated roads are now making, there are chances for new economies in the closer supervision of the car service. In the matter of motor maintenance, for example, there is little doubt that the flashing which has created trouble on some lines can be very much cut down by proper instruction of trainmen in the handling of the controller. It is a mistake to suppose that any automatic device can entirely free a road from motor trouble due to too fast feeding of the controller, or to movement from series to parallel at a time when one or more pairs of wheels are slipping on a grade. Again, the improper handling of the air or hand brakes, which leads directly to flat wheels, loose truck or car body parts, excessive brake shoes and wheel wear, and possible overheating of compressors, can be largely eliminated with proper inspection. There are, of course, other causes of motor flashes, such as grounds on the armatures or brush holders, inadequate insulation in the commutator and brush holders, insufficient tension in the brush springs, too greatly worn brushes, crossed leads and even wear in the motor suspension. In fact, cases have occurred in which motor flashing was attributed to the wear of the suspension bar on the lugs, causing the motor to lift at every start and tending to throw the armature out of balance. The operating department can help in the removal of these troubles by prompter defect reports.

Helping the Claim Department

The purpose of maintenance is to keep all equipment in safe and serviceable condition, to prevent accidents and to avoid breakdowns. When a car breaks down it is a matter to be investigated and adjusted between departments. The responsibility should be placed where it belongs and the proper steps should be taken to correct the defects of equipment or discipline found to be the cause. But when an accident happens the matter is one which concerns more than the internal organization of the company. Settlement must be made by the company, acting through its claim department, with an outsider who appeals to a jury frequently with manufactured and fraudulent evidence. It is important, therefore, that the claim department be supplied with full details of the condition of the equipment involved in the accident both before and at the time of its occurrence. Systematic records of inspection and maintenance, in such form that the facts are easily accessible, afford the best evidence at the disposal of the company's lawyers in contesting any kind of injury claim. The records may be kept primarily for another purpose, but they can be modified or expanded with this idea in view and so made doubly valuable.

A close co-operation should then be established between the mechanical and claim departments in the system of inspection and maintenance followed, and the forms should be so arranged that they will supply, if necessary, the information required by both. In some companies it is even the practice to turn over to the claim department for permanent filing the motormen's defect reports, or signing-in sheets, as well as the inspector's reports of the condition of cars returned to service after repairs have been made. The claim department thus has a record of the daily condition of each car and a certificate of good condition after the last shopping. It is enabled to verify or dispute immediately any claim of defective equipment made as a primary or contributing cause of injury. With such a plan the numerous other reports and records kept by the mechanical department are also, of course, always at the disposal of the claim department for corroboration or explanation, but they are a means of last resort. The ordinary questions of fact arising are usually answered from the records first mentioned.

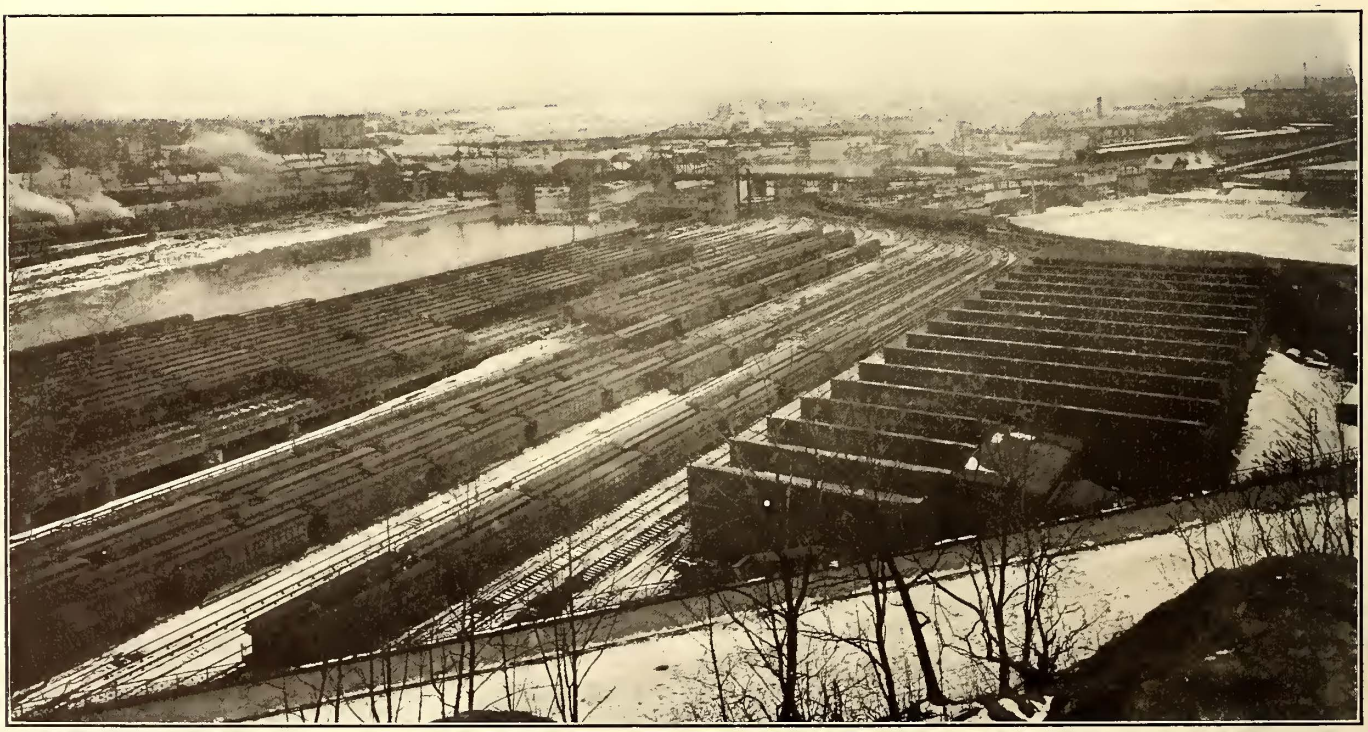
The moral effect of systematic and careful records of maintenance and inspection when presented as evidence before a jury is great. They are much more convincing than verbal testimony of employees whose memory may be good or bad. If the company can show daily or weekly records of inspection for periods before and after an accident and can back these records up with certificates of good order immediately preceding the accident, it has established the best part of its case. As an example of this a suit was recently brought against a large interurban road by a fireman in the power house who was injured by the bursting of a main steam pipe in the boiler room. The claim was made that the plant was overloaded constantly and that the boilers were being operated at excessive pressures; furthermore, that the condition of the plant was bad and that no repairs had been made since it was started. The company presented to the jury copies of the daily power station log showing the load on the engines and boilers covering a period of two months before and after the explosion, copies of the recording gages giving the pressure carried at the time of the accident and for several hours preceding it, copies of the boiler inspection records indicating that the boiler and connections had been cleaned and inspected only a week before and had been inspected regularly every three months, and in addition the maintenance records of the entire plant since it was first put in operation. The jury was satisfied from these records that the accident was unforeseen and not due to bad maintenance or overloading and returned its verdict accordingly. Had the company been compelled to rely on the testimony of the plaintiff's fellow employees or its chief engineer the result, quite possibly, would have been different.

The claim department often acts most efficiently when it acts quickly, and there is advantage in having the required information at hand without unraveling red tape in interdepartmental correspondence. If it is supplied promptly with copies of maintenance records from day to day it is in a position to make quick decisions as to settlement or contest of claims. It involves little or no trouble for the mechanical department to make duplicate copies of records for the files of the claim department or even to trust it with the single original. The form and scope of reports can usually be easily arranged to meet the needs of the latter without sacrificing any features of value to the heads of other departments.

THE CAR EQUIPMENT DEPARTMENT OF THE INTERBOROUGH RAPID TRANSIT COMPANY—METHODS OF CAR INSPECTION, LUBRICATION PRACTICE, CAR CLEANING AND LABOR PAYMENT

Although it cannot be asserted with reason that the inspection and maintenance practice of all railways should be uniform, there are certain principles which can be followed by them irrespective of size or operating conditions. What, for instance, has the size of a road to do with the accurate determination of the inspection cost per ton-mile or the comparative merits of time versus mileage inspection? The knowledge of inspection costs of different kinds of rolling stock on the ton-mile basis means as much to the small city railway as to the large one; and the fixation of the inspection mileage found to harmonize with the greatest economy for local conditions should be a prime object everywhere. For these, as well as other reasons, many of the Interborough Rapid Transit Company's car inspection practices are of universal application, as they form part of a system which catches the weak spots in men and material and points the way to betterment. The reduction attendant upon the adoption of a mileage inspection system by this company was mentioned last week. It is now in place to examine briefly the facilities for inspection and

VIEW OF THE 148TH STREET SUBWAY SHOPS AND INSPECTION YARD FROM THE REAR

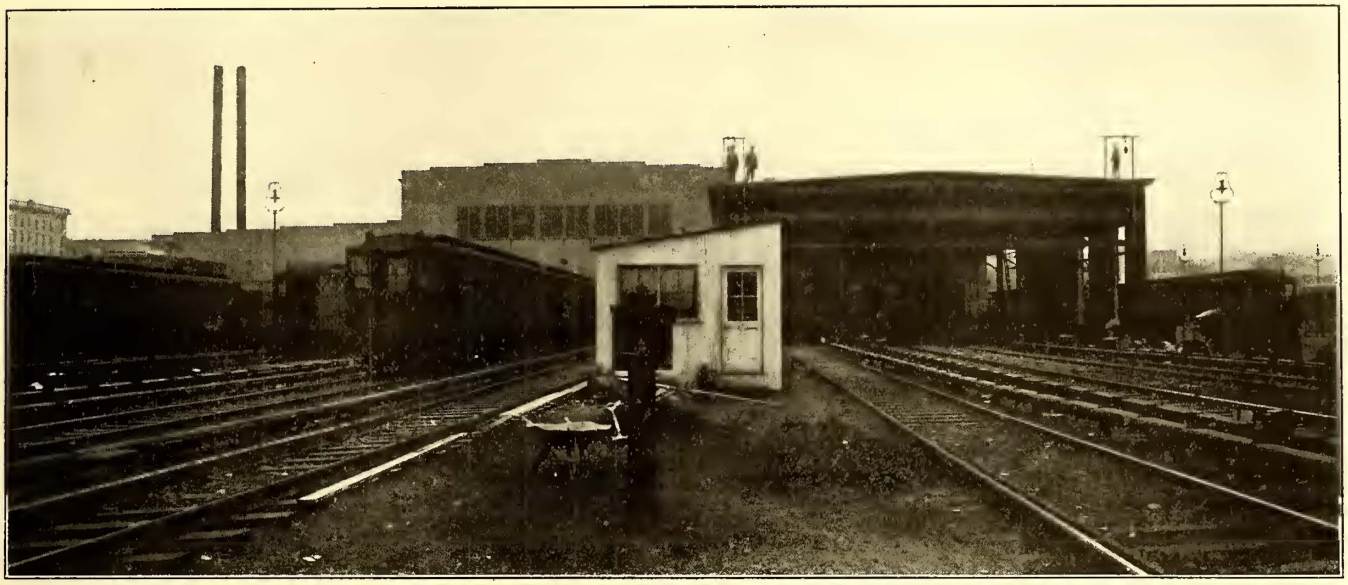


ELEVATED INSPECTION SHOP AND STORAGE YARD AT 159TH STREET AND EIGHTH AVENUE

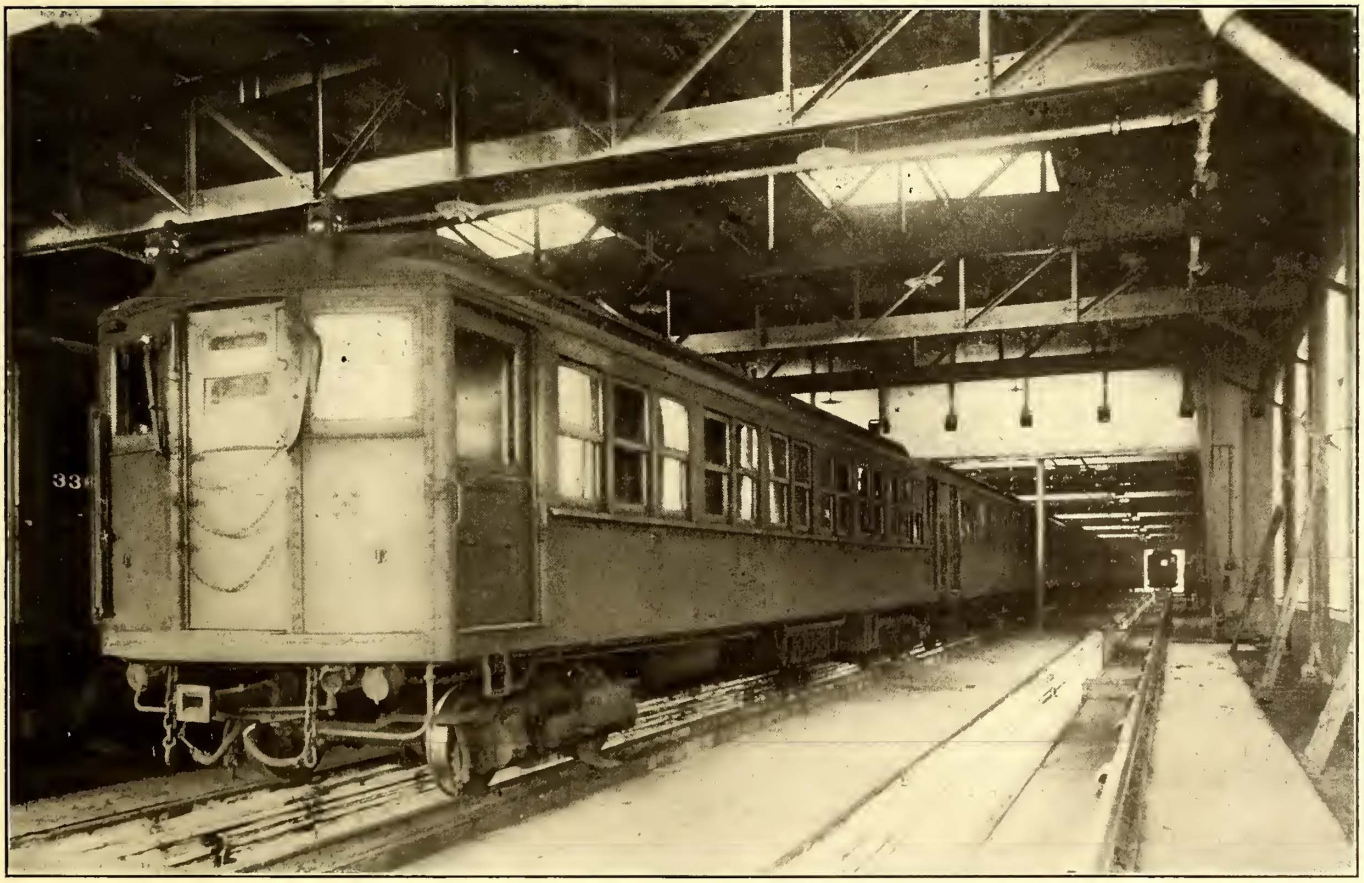
then to enter into the records of the department describing the nature and value of the statistics thus derived. This will be followed by a study of the inspection and cleaning.

THE INSPECTION DEPOTS

There are five inspection points on the Interborough Rapid Transit Company's system, two for the subway and three for the elevated lines. The cars on the Broadway division are cared for in an underground shop which is formed by a widening of the subway between the 137th and 145th Street stations to allow trackage for 150 cars. The other subway barn is at 148th Street and Lenox Avenue adjoining the maintenance plant of the company at that point. This inspection shed originally contained four tracks about 240 ft. long, or enough to accommodate a six-car train. The adoption of eight-car trains made it desirable to extend the building accordingly so that all inspection could be carried out under cover. This extension has recently been completed and in construction follows the original building, which it may be interesting to note is one of the pioneer reinforced concrete car shops and, in fact, was by far the largest of its kind when erected in 1903. The inspection shop is a steel structure made up of four rows of center columns, which consist of 16-ft. bays,



FRONT VIEW OF INSPECTION DEPOT AND SHOPS AT 148TH STREET AND LENOX AVENUE



AN EIGHT-CAR TRAIN IN THE 148TH STREET INSPECTION SHOP

supporting the roof trusses. The foundations for these center columns are concrete piers mounted on piles. After the erection of the steel skeleton the walls were constructed by using furring channels on which expanded metal laths were fastened as a base for the concrete covering. The roof is of concrete slabs, reinforced with expanded metal laths and finished with cement and mortar before waterproofing.

The three inspection shops of the Elevated division were built when the motive power on that line was changed from steam to electricity. All are of the same general design, with brick walls and saw-tooth roofs. The largest of these installations is the structure at 159th Street and Eighth Avenue, which contains four eight-car, three seven-car and three six-car tracks. At 129th Street and Second Avenue there is provision for five tracks with pits extended outside for handling seven-car trains, while the 179th Street building holds just five seven-car trains on as many tracks.

CAR MILEAGE RECORD

The accompanying folio from the mileage record book is reproduced to show with what care the performance of every car is watched and how closely the actual inspection approaches the 1000 miles laid down as a standard. Thus, the page illustrated shows that car No. 3342 was inspected on Jan. 3, after making 969 miles; the second inspection was made six days later, in which period the car had run 989 miles; the third inspection was after a run of 1020 miles, etc. Notations are also made in red ink on this report to indicate when the car received a general oiling as well as the dates it entered and left the maintenance shops. Looking over the assembly figures for the entire year, placed at the bottom of the record, and comparing them with the shop notations, it will be seen that while the car made 60,358 miles, it was in the shop just four times. As there were 60 inspections, it follows that the average mileage per inspection was 1000.50, which is remarkably close to the figure set.

A daily summary of cars inspected is reproduced for each division of the elevated and subway lines. This report is particularly interesting in its comparisons of the average mileage and time intervals between motor and trail car inspections at the different working centers besides showing the amount of rolling stock handled.

The total number of cars operated during 1906 was 1392 on the elevated and 793 in the subway, the former being subjected to 60,911 inspections and the latter to 26,349. The elevated inspection for 1906 cost $168,111 and the subway inspection $203,098. The comparison of inspection

CAR No. 3342.

Date	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	....	.....	1018	965	.....	.....	To Shop.	.....	.....	....	.....	.....
2	....	996	.....	.....	.....	.....	From Shop.	.....	993	....	.....	1020
3	969	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
4	....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
5	....	.....	.....	.....	.....	.....	.....	1012	.....	....	1024	.....
6	....	.....	.....	.....	.....	1031	.....	.....	.....	989	.....	.....
7	....	.....	983	.....	1047	.....	.....	.....	.....	....	.....	.....
8	....	.....	.....	1013	.....	.....	960	.....	1012	....	.....	989
9	989	1038	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
10	....	.....	.....	.....	.....	.....	.....	980	.....	....	.....	.....
11	....	.....	.....	.....	.....	974	.....	.....	.....	....	989	.....
12	....	.....	.....	.....	.....	.....	.....	.....	.....	102	0....	.....
13	....	.....	1012	.....	1018	.....	981	.....	980	....	.....	.....
14	....	998	.....	980	.....	.....	.....	.....	.....	....	.....	1047
15	....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
16	102	0....	.....	.....	.....	.....	.....	1047	.....	....	.....	.....
17	....	.....	.....	.....	.....	993	.....	.....	.....	....	1013	To Shop. From Shop.
18	....	.....	1043	.....	.....	.....	.....	.....	.....	976	.....	.....
19	....	.....	.....	.....	1012	.....	1030	.....	1047	....	.....	.....
20	....	.....	.....	993	.....	.....	.....	.....	.....	....	.....	.....
21	1046	1021	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
22	....	.....	.....	.....	.....	.....	.....	.....	To Shop.	....	989 Oiled	.....
23	....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	981
24	....	.....	To Shop.	.....	.....	1018	.....	.....	From Shop	1034	.....	.....
25	....	.....	.....	.....	958 Oiled	.....	1038	.....	.....	....	.....	.....
26	....	.....	From Shop.	1018	.....	.....	.....	.....	.....	....	.....	.....
27	988	976 Oiled	.....	.....	.....	.....	.....	.....	.....	....	.....	.....
28	....	.....	.....	.....	.....	.....	.....	976 Oiled	.....	....	978	.....
29	....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....	1047
30	....	.....	.....	.....	.....	.....	993	.....	1018	....	.....	.....
31	....	.....	.....	979	1047	1050	.....	.....	.....	987	.....	.....

Total mileage for year..... 60,358.
Total number of inspections..... 60.
Average number of miles per inspection..... 1,000.50
Maximum number of miles per inspection..... 1050.
Minimum number of miles per inspection..... 958.

CAR RECORD FOR MILEAGE BETWEEN INSPECTIONS AND OVERHAULINGS

SUMMARY OF CARS INSPECTED MANHATTAN DIVISION.

129th St. Barn	For Average
No. motor cars inspected	26 / 59
No. trailer cars inspected	13 / 35
No. trains through barn	19 / 15
Motor cars due not inspected	5
Trailer cars due not inspected	2
MOTORS	
Mileage: 700–800 / 800–900 / 900–1000 / 1000–1100	
No. cars: 3 / 8 / 10 / 5	
Average..... 871.11 miles	
MOTORS	
Days out: 5 / 6 / 7 / 8 / 9 / 10 / 11 / 13 / 14 / 16	
No. cars: 3 / 4 / 4 / 4 / 2 / 4 / 1 / 2 / 1 / 1	
Average..... 8.23 days	
TRAILERS	
Mileage: 1400–1500 / 1500–1600 / 1600–1700 / 2100–2200	
No. cars: 1 / 5 / 6 / 1	
Average..... 1,627.38 miles	
TRAILERS	
Days out: 9 / 10 / 11 / 12 / 13 / 14 / 17 / 26 / 27	
No. cars: 1 / 1 / 1 / 1 / 2 / 2 / 1 / 2 / 1	
Average..... 15.38 days	

179th St. Barn	For Average
No. motor cars inspected	34 / 68
No. trailer cars inspected	21 / 60
No trains through barn	19 / 21
Motor cars due not inspected	12
Trailer cars due not inspected	7
MOTORS	
Mileage: 800–900 / 900–1000 / 1000–1100 / 1100–1200 / 1200–1300 / 1500–1600	
No. cars: 6 / 15 / 6 / 5 / 1 / 1	
Average..... 999.47 miles	
MOTORS	
Days out: 4 / 5 / 6 / 7 / 8 / 9 / 10	
No. cars: 1 / 3 / 6 / 9 / 5 / 10 / 2	
Average..... 7.54 days	
TRAILERS	
Mileage: 600–700 / 700–800 / 800–900 / 900–1000 / 1000–1100 / 1200–1300 / 1900–2000 / 2000–2100 / 2100–2200	
No. cars: 1 / 1 / 2 / 4 / 2 / 1 / 2 / 1 / 1	
Average..... 1,163.61 miles	
TRAILERS	
Days out: 5 / 6 / 7 / 8 / 9 / 15 / 17 / 18 / 19	
No. cars: 1 / 3 / 4 / 2 / 2 / 1 / 2 / 3 / 3	
Average..... 11.28 days	

159th St. Barn	For Average
No. motor cars inspected	56 / 105
No. trailer cars inspected	18 / 60
No. trains through barn	26 / 32
Motor cars due not inspected	0 / ..
Trailer cars due not inspected	20 / ..
MOTORS	
Mileage: 700–800 / 800–900 / 900–1000 / 1000–1100	
No. cars: 14 / 29 / 12 / 3	
Average..... 851.75 miles	
MOTORS	
Days out: 5 / 6 / 7 / 8 / 9 / 10 / 12	
No. cars: 15 / 14 / 15 / 8 / 2 / 1 / 1	
Average..... 6.52 days	
TRAILERS	
Mileage: 800–900 / 1000–1100 / 1220–1320 / 1300–1400 / 1400–1500 / 1600–1700 / 1800–1900 / 2000–2100	
No. cars: 1 / 1 / 4 / 2 / 6 / 2 / 1 / 1	
Average..... 1,402.25 miles	
TRAILERS	
Days out: 7 / 9 / 10 / 11 / 12 / 13 / 14 / 16 / 20	
No. cars: 2 / 1 / 5 / 1 / 3 / 1 / 3 / 1 / 1	
Average..... 11.74 days	

cost on a ton-mile basis between the two classes of service shows clearly the harder conditions in the subway, the cost per 1000 ton-miles being only $.123 on the Manhattan system and $.1763 or 69 per cent more in the subway.

ORDERING CARS FOR INSPECTION

Each day the train clerks at the different terminals make out lists of cars which have run the specified mileage as checked from the known lengths of the trips made. A copy of this list is given to the inspection foreman, yardmaster and dispatcher. The Transportation Department then removes from service the cars due for inspection and, when convenient, groups them into solid inspection trains. As soon as the cars have entered the shop, the local clerk hangs to the truss rod of each car a metal holder which contains a white card if only ordinary inspection is wanted or a red card when general oiling is to be included. As this card is the fundamental feature of the inspection system, its uses and merits will be considered in detail.

THE INSPECTION CARD

The inspection card is divided into as many sections as the work covers, space being left at the top for the car number and the date of the inspection. As each man completes his specified duties, he signs his name in the proper section of the card, the latter remaining in the holder until every signature has been affixed. Then every item is checked up by two inspectors to make sure that there has been no skipping, after which the inspection card is taken off by the man who returns the rolling stock to the Transportation Department.

The moral influence which the signature record exerts on the men is one of the most striking advantages of the inspection card, because it affords so sure and clear a means of fixing the responsibility for work done. They know that a failure of any kind will be quickly traced to its source, and this knowledge has imbued them with a wholesome fear of the inevitable disciplining from the foreman when a careless job has been traced to the wrongdoer.

Besides forming the basis of numerous improvements in equipment through its history of failures, this simple inspection card has proved a most valuable aid to the Claim Department of the company in the settlement of damage suits. It cannot be repeated too often that the inspection system is intimately connected with the amount spent to fight or pay claims. It is not enough, however, to have efficient methods of carrying on the inspection. The work must be backed up by a recording system that will prove things if the Claim Department is to secure any benefit from efficient car inspection. When the claim agent calls for a report on the condition of a car before an accident, the records furnished ought to show when the car was last examined and bear the signature of every man who worked on it. In fact, each record must be so good that it will be acceptable evidence in law; and this can only be accomplished by a system of the character described, which substitutes for greasy, illegible pocket books or arbitrary check marks without legal standing a plain card whose collection of signatures is evidence which cannot be evaded or deprecated.

The realization of the high value of this card system by the Car Equipment Department is evidenced by its practice of filing every card for at least two years. If within that period the Transportation Department sends in a report of an accident to or on a given car, the record is taken out of the ordinary file and placed in the special Accident file, where it is available for the use of the Legal Department. The Car Equipment Department also records the last addresses of the men whose signatures are on these cards and whether they are still in the company's employ.

SUMMARY OF CARS INSPECTED SUBWAY DIVISION.

137th St. Barn	For Average	148th St. Barn	For Average
No. motor cars inspected....28	45	No. motor cars inspected....37	65
No. trailer cars inspected....12	..	No. trailer cars inspected....17	..
No. trains through barn....23	17	No. trains through barn....13	24
Motor cars due not inspected....17	..	Motor cars due not inspected....32	..
Trailer cars due not inspected....12	..	Trailer cars due not inspected....19	..

MOTORS

	700 800	800 900	900 1000	1000 1100	1100 1200	1200 1300	1300 1400	1400 1500
Mileage	800 900	900 1000	1000 1100	1100 1200	1200 1300	1300 1400	1400 1500	1500
No. cars	2	2	3	8	3	6	2	2

Average....1,106.00 miles

MOTORS

	800 900	900 1000	1000 1100	1100 1200	1200 1300	1400 1500
Mileage	900 1000	1000 1100	1100 1200	1200 1300	1300 1400	1500 1600
No. cars	12	7	11	3	2	2

Average....1,005.64 miles

MOTORS

Days out	3	4	5	6	7	8	9	10	12	13	14	16
No. cars	3	1	1	2	1	3	4	2	1	1	3	1

Average....7.14 days

MOTORS

Days out	5	6	7	8	9	10	12	16
No. cars	2	6	6	6	7	7	2	1

Average....8.35 days

TRAILERS

	800 900	900 1000	1000 1100	1200 1300	1300 1400	1500 1600
Mileage	900	1000	1100	1300	1400	1600
No. cars	3	1	4	1	2	1

Average....1,093.91 miles

TRAILERS

	900 1000	1000 1100	1100 1200	1200 1300	1400 1500	1700 1800
Mileage	1000	1100	1200	1300	1500	1800
No. cars	1	3	8	3	1	1

Average....1,185.83 miles

TRAILERS

Days out	6	7	8	9	16
No. cars	3	2	4	2	1

Average....8.16 days

TRAILERS

Days out	2	6	7	9	10	12	13	16
No. cars	2	2	2	5	2	2	1	1

Average....8.58 days

INSPECTION AND REPAIR CARD.

Car No.....Date.....

Contactors, reversers, circuit breaker, main fuses, bus fuses and rheostats.	
Wheels, axles, truck transoms, swing hangers, equalizer bars, draw bars, king pins, center plates and bolts.	
Insp.	
Rep.	
Controllers and switchboards.	
Motor repairs.	
Motors inspected, armatures gaged.	
Jumpers and sockets.	
Light and heat circuits. Contact device.	
Shoe fuses.	
Control circuit tested.	
Trip device and air hose.	
Brake shoes applied and trucks inspected and repaired.	
Brakes inspected and tested.	
Air compressor.	
Air governor.	
Platform fittings.	
Car body parts.	

LUBRICATION.

Motorman's valves.	
Triple.	
Armature bearings.	
Journals.	
Axle bearings and gears.	
Draft, brake rigging, center plates and side bearings.	

INSPECTION OF MOTORS—SOME RESULTING IMPROVEMENTS IN BRUSHES AND MOTORS

The general plan followed with regard to the motors is to inspect them for every 1000-mile run. The company was the pioneer in working out mileage inspection and the good results which have followed from this practice have abundantly justified its departure from time-interval inspection.

The general plan followed in making these 1000-mile inspections is to have men clean the apparatus and adjust parts, after which an inspector goes over each section of the work. The inspection of a motor begins with cleaning by compressed air. The armature clearance is measured by the gager, who uses a ⅛-in. and 3/16-in. gage to slip across the pole faces. If the smaller gage will not pass, the waste is pulled out of the armature housings and the bearings examined to find the cause of wear. Bolts and nuts on the motors are tried for tightness by the truckman. Commutators are sandpapered as follows: After the truck has been jacked up to let the car wheels clear, the motor is started so that the revolving commutator is smoothed by sandpaper held on a spring block, which is kept in position through a long lever.

One of the numerous improvements due directly to the motor inspection has been the elimination of the motor brush failures, which resulted in the burning of commutators and brush holders, a condition which was greatly aggravated by the unusually large currents which had to be carried by the brushes per unit area. The number of commutators which required sanding owing to flat spots and high mica became so great that a special effort was made to find a carbon brush of uniform density. The best brush so far found to meet the conditions is a French product known as Le Carbone. The records show that during the last four months of 1907 this brush cost $.000173 per car-mile, as compared with the old brush at $.000448 per car-mile, while the average mileage per brush was 15,580.79, against the average of 3,949.15 miles secured previous to the introduction of the improvement. The number of sandpapered commutators was reduced to 402 during the above period, as compared with a total of 2293 for the same months of 1906.

A prime cause in expediting the advent of the commutating pole motor in railway operation was the overwhelming evidence offered by this company's inspection reports showing the straight series motor to be unequal to giving efficient commutation with the high potential and heavy currents of the elevated and subway service. This subject will be taken up in greater detail in the article on the work of this department's engineers.

Thus the company's accurate records of its own experiences have not only reduced its own commutator troubles, but have likewise facilitated the introduction of an important advance in direct-current motor design of benefit to many others.

INSPECTION OF CONTROL AND MISCELLANEOUS ELECTRICAL APPARATUS

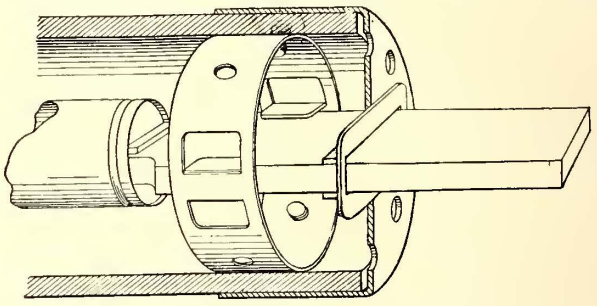
The cleaning and inspection of the master controllers and switches in the cab usually require the services of two men per inspection shop. The controllers are blown out, defective parts removed, fingers adjusted and the segments and bearings lubricated. One man goes over the contactors, wipes the interlock plates and blocks, shellacking the latter about every three months. The circuit breaker, control rheostats and reverser are also examined. If a grid is broken or burnt, the entire rheostat is immediately replaced.

INSPECTION OF CONTACT SHOES—THE SHOE FUSE

The contact shoes are inspected to the extent of gaging their height, trying all bolts and ringing out the enclosed shoe fuse with a bell. After a periodical blow-out, the fuse-box and part of the beam near it are painted with an insulating compound.

The type of third-rail shoe fuse employed is another instance of a specialty developed to meet the subway conditions. It was essential that this fuse should be enclosed and capable of opening tremendous short circuits without any disturbance or danger to throw passengers into a panic, and it was evident from the start that the ordinary enclosed fuse would be unequal to this condition.

To meet these requirements the D & W Fuse Company evolved what has since become known as the "cylinder link" fuse, a form of fusible link in which a maximum radiating surface is secured with a minimum volume of metal for any given current volume. This fusible link is enclosed in a fiber tube, surrounded by porous filling, in precisely the same manner as ordinarily employed in enclosed fuse construction. The mechanical details of construction in this fuse were likewise carefully looked after, the method of securing the caps to the fiber tube being unique in fuse design. This is clearly illustrated in the cut disclosing the guide ring which acts both as a guide for the fuse



METHOD OF SECURING CAPS TO FIBRE TUBE OF FUSE

terminals and as fastenings into which the cap screws are set, positively prohibiting the dragging out of the screw should the fuse be subjected to severe pressure in cases of short circuit.

After extended investigations lasting over a year it was demonstrated that fuses constructed with this form of fusible link would operate without disturbance even when handling direct short circuits from the third-rail to the structure where every other type of link enclosed in casings of anywhere near similar dimensions would explode with the greatest violence. How severe these conditions were will be better understood when it is explained that current rushes through the fuse in excess of 18,000 amp were observed during these investigations, while the potential drop of the circuit was practically negligible, the potential on the line being approximately 625 volts.

When it became necessary to provide equipment for the subway division further tests were conducted on fuses of very much larger capacity, running up to 600 and 800 amp continuous load. Here the cylinder link again demonstrated its superiority over all other types. The first equipment for the subway called for fuses of 400-amp capacity and it was supposed that these would be ample to meet the requirements of the subway traffic. After being in operation for over a year, however, it was found desirable to increase the capacity, as the tremendously heavy traffic and rapid acceleration of the trains frequently blew the fuses when there was no trouble on the line. The entire equipment,

therefore, was changed over to fuses of about 650-amp capacity. The operation of these fuses in service has proved most satisfactory in every way, especially on short circuit. It costs about $0.22 each to refill the 400-amp fuses.

Originally these fuses were designed to be mounted on the beam supporting the third-rail shoe. It was found, however, that the vibration to which this beam is subjected has a deteriorating effect upon the fuse. The shoe fuses

INTERBOROUGH RAPID TRANSIT COMPANY.

MR. J. S. DOYLE, Superintendent Car Equipment. Date, January 15, '08

DEAR SIR:

LAMPS REPLACED.

Car No.	Burned out	Broken	Missing	Car No.	Burned out	Broken	Missing
483	1	...	...	...	.....	...	...
1003	2	...	...	...	.....	...	...
156	1	...	...	...	.....	...	...
260	.....	1	...	...	.....	...	...
1380	.....	...	2	...	.....	...	...

Total lamps replaced in Cars on above date...7
Total lamps replaced in House on above date. 5

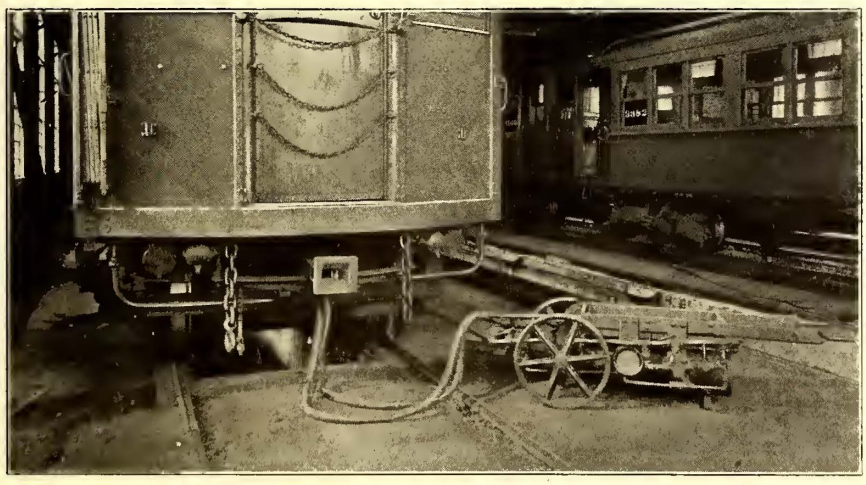
.....
FOREMAN

LAMP RECORD

are now mounted on a spring supported block carried on the shoe beam. The springs consist of two single-leaf semi-elliptics.

LAMP PRACTICE

The car equipment department has been making a study of the lamp question on the car-mile basis. At present lamps are purchased according to the company's specifications, but it is probable that in the future they will be bought on a manufacturer's guarantee at so much per 1000 car-miles, thus relieving the company of all losses from failure, broken lamps and the like.



PORTABLE TRIPLE VALVE TESTER USED BY AIR-BRAKE INSPECTOR

INSPECTING TRUCKS AND WHEELS

The inspection of trucks and wheels is held to be of such paramount importance that the work is done on a bonus system, a reward of one or more days' pay being given to every man who finds such defects as a cracked equalizer bar, a broken swing hanger, a loose wheel or a broken spoke. The steel-tired wheel with cast-steel centers was one of the many truck parts which proved unable to cope with the rigorous subway conditions, and, in fact, the axles and forged side frame are about all that has been retained of the original truck designs. It is noteworthy, too, that the thorough inspection and record system of this department was primarily responsible for the correction of early faults before dangerous failures made such correction obligatory.

While on the subject of wheel inspection, it may be noted here that the company has placed Schoen solid forged and rolled steel wheels on practically all motor trucks whereby tire and wheel failures have been entirely eliminated.

AIR-BRAKE INSPECTION

As the acceleration and retardation of rolling stock are complementary sides of the problem of schedule maintenance, it follows that the best results are obtainable from the motive equipment only when supplemented by an equivalent braking system. In view of the quick and comfortable braking demanded in the subway, the Interborough Rapid Transit Company wisely decided to use the high-speed, quick-action, graduated release system exclusively in place of the usual quick-action automatic air-brake. The following paragraphs will give a fair idea of the company's inspection practice with regard to this important part of the apparatus.

Every part of the brake rigging is examined every time a car is brought in for inspection. The piston travel is kept at 4 in. and the brakes finally tested with 70 lb. train-line pressure. After the oiling and inspection of air compressors and governors all the cars in the train, on account of multiple-unit operation, have their governors tested to determine the cutting in and out pressures and to insure that all compressors are in working order when they leave the shop. The governors are tried by using an inspector's test gage, connected to the main reservoir line; if out of adjustment they are set to 85 lb. cutting-in and 100 lb. cutting-out pressures. The reservoirs of all cars passing through the shops are drained at every inspection, irrespective of the nightly drainage. Motorman's valves are taken apart and lubricated every 15 days. The air-hose and the tripping device for automatically applying the brakes are also tried out at each inspection.

Every shop has one man assigned to the cleaning of triple valves on every car once in 30 days. The valves are tested monthly for leaky pistons by setting all the brakes of a train and then allowing the train-line to be charged from the reservoir line very slowly by the portable triple-valve tester, illustrated on this page. If the valves are leaking madly the pressure builds up on the auxiliary side of the piston and the triple fails to release the brakes. The testing machine is mounted on a small cart and consists mainly of a controlling valve and a reservoir. This controlling valve is connected through hose between the reservoir and the train-lines at the end of the last car in the train. If a triple valve fails to keep up to the standard it is removed and sent to the air-brake department for thorough overhauling.

RELEASING CARS FOR SERVICE

After the completion of the different steps outlined bus and train-line jumpers are examined for proper insertion

and the control circuit tried by operating the controller on the end of the train and noting on each car the pick-up of contactors and circuit breaker as well as the throw of the reverser. The brakes are also tried, after which the train is reported to the yardmaster as ready for duty. Generally the inspection period ranges from 35 to 50 minutes per train. Such cars as are found beyond the range of the inspection work are taken out of the train and tagged for the maintenance shop.

TERMINAL INSPECTION PRACTICE

The examination of cars is not confined to the shop inspectors, as there are men at each terminal to inspect for troubles reported by the motormen which can be remedied on the spot. The principal value of this practice is the saving of delays from trifling causes. When the motorman does not specify the right car the reported train is sent to an inspection shop, as there is little time for inspection at these terminals. The latter procedure also is followed when shoe or main fuses are blown on the road. In connection with this matter two pages are given below from the motorman's report book which contains sheets 14¼ in. x 18¾ in.

INTERBOROUGH RAPID TRANSIT CO.

TRAINMAN'S REPORT.

Car No.	Time	Name	Report
3052	8:46A.M.	Ridel	Dead motor
3372	9:10A.M.	Quinn	Bad order pump
3064	9:48A.M.	A. O'Brien	Brakes out of order
3363	10:10A.M.	A. Path	Contactor trouble
3135	10:35A.M.	D. Sullivan	Lights out of order
3537	11:05A.M.	G. Blanck	Dead motor
3541	11:15A.M.	D. Lenehan	Bad brakes
3299	11:33A.M.	A. Rutger	Flat wheels
3487	11:45A.M.	E. Curren	Controller trouble
3607	12:10P.M.	J. Brown	Bad order tripper device

in size, ruled for one line per car. One page is for the trainman's report of the trouble, while the opposite page is used by the shopman to indicate the real source of trouble and mentioning the repairs made. This scheme is of value in educating the trainmen and showing up how much they really know about the valuable machinery in their hands.

LUBRICATION PRACTICE

The splendid records which the Interborough Rapid Transit Company has to offer on its lubrication practice should open the eyes of those electric railway managers who fail to realize the importance of proper oiling in its bearing on power consumption and life of rolling stock irrespective of the cost of lubrication alone. The experience of this company has shown the mileage system to be the only one which places the cars of each class of rolling stock on a fair footing, and by going still further in adopting the ton-mile unit logical comparisons between different cars and different railroads have been made practicable.

The oiling methods now applied in the Car Equipment Department represent the united experience of the Interborough Rapid Transit Company and the Galena Signal Oil Company, which has a yearly contract with the railway company for lubrication of car equipment at a guaranteed cost per 1000 car-miles. The Galena Company does not confine itself merely to supplying lubricants, but keeps in constant touch with the Car Equipment Department through a district manager. This manager keeps strict watch of the material supplied to and the costs shown by the different divisions, summarizing his observations in a monthly report addressed to the superintendent of car equipment. The letter dated Nov. 13, 1907, reproduced on this page, is a fair example of the subjects taken up in these monthly reports. The district manager also visits the depots and shops from time to time, taking up with the different barn foremen the subject of lubrication as reflected by their last costs as compared with the preceding costs. This supervision extends over the mechanical conditions which exist as to journals and bearings and all other points which bear directly upon the subject he has in hand. He also inspects the oil houses, saturating tanks and filters with which the shops and barns are provided. At various times trips are taken over the different routes and notes made of the condition of the elevated and subway structure, and the findings noted in a special report. The latter investigation is made mainly to discover evidence of wasteful oiling. It is also within the scope of the lubrication expert to advise the railway company as to

INTERBOROUGH RAPID TRANSIT CO.

SHOP REPAIR REPORT.

Car No.	Trouble	Repairs	Name
3052	Dead motor	Found circuit breaker wipe spring broken	Malloy
3372	Pump trouble	Grounded Christensen pump armature due to insulation falling down	Soden
3064	Bad order brakes	Found broken slack adjuster screw	Olney
3363	Contactor trouble	Due to weak wipe spring	Murray
3135	Lights out of order	Due to 10 C.P. lamp missing	Bennett
3537	Dead motor	Due to broken circuit breaker toggle	Malloy
3541	Bad brake	Due to broken brake rod	Alwill
3299	Flat wheels	Due to car having been reversed	Car sent to shop
3487	Controller trouble	Broken flash shield No. 1 end controller	Hobbs
3607	Bad order tripper device	Broken lock washer on bolt allowing same to become loose	Quinn

————, Nov. 13, 1907.

J. S. DOYLE,
Supt. Car Equipment,
Interborough Rapid Transit Company:

The Manhattan Division shows a material reduction in cost per 1000 car miles for October as compared with September.

	Motor cars.	Trailer cars.	All cars.
129th Street barn decreased	$0.031	$0.008	$0.022
179th Street barn decreased	.015	.002	.010
159th Street barn decreased	.057	.004	.043

The 159th Street barn had the opportunity and has made the greatest decrease, and is now about 2½ per 1000 car miles higher than either 129th Street or 179th Street barns. A further slight decrease in the motor car cost at the 159th Street barn will bring that barn to an equal cost with the other barns.

The Subway Division decreased by about $0.017 its cost for October as compared with September. The cost on motor cars decreased $0.042 per 1000 car miles, but increased on trailer cars $0.022.

	Motor cars.	Trailer cars.	All cars.
137th Street barn decreased	$0.049	Inc. $0.009	Dec. $0.027
148th Street barn decreased	.028	Inc. .029	Dec. .006

The increase on the Subway Division is due largely to increase on trailer cars, for instance:

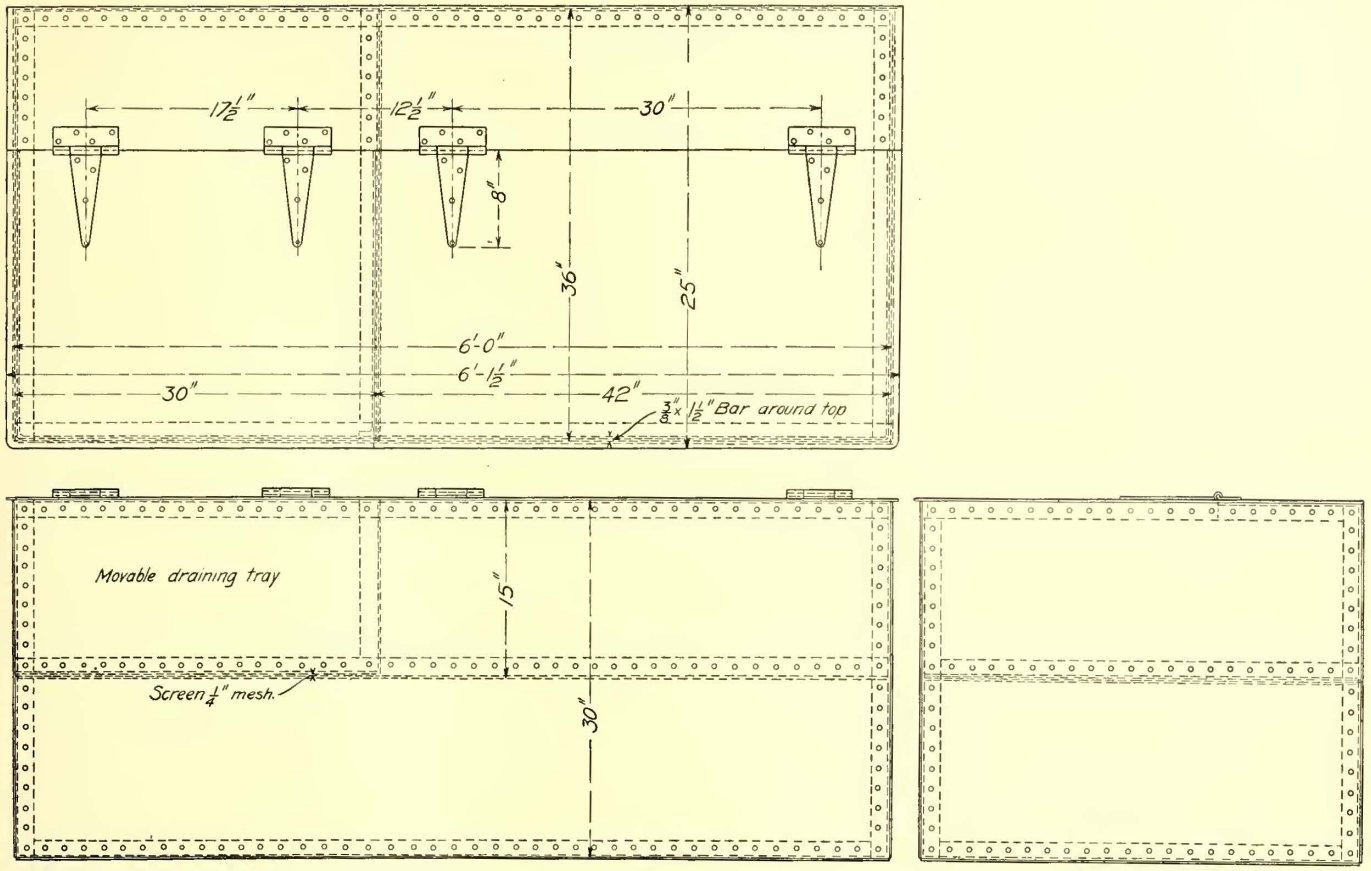
The 137th Street barn used on an average for the first seven months of this year on trailer cars 67 gallons per month. Since Aug. 1 they have used 773 gallons or 258 gallons per month.

The 148th Street barn has doubled its average consumption on trailer cars in October as compared with the previous six months. The cost on the Subway Division is about 14 cents per 1000 car miles lower so far during 1907 than the cost for the year 1906.

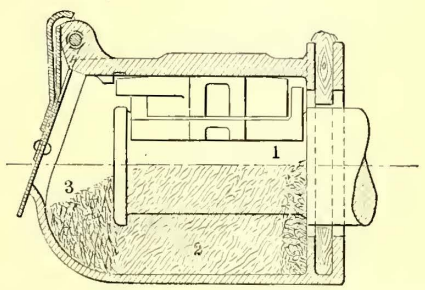
Very truly yours,
WILLIAM P. WESCOTT.

further improvements in methods for storing or applying lubricants. Some of these are noted later in this article.

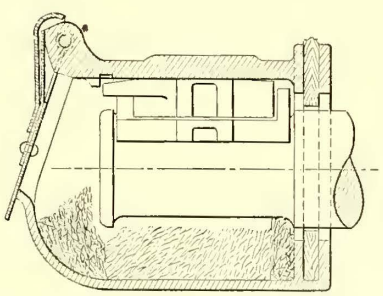
The tabulation of oil and grease consumption is made up every month at the several barns and shops. These reports are sent immediately to the superintendent of car



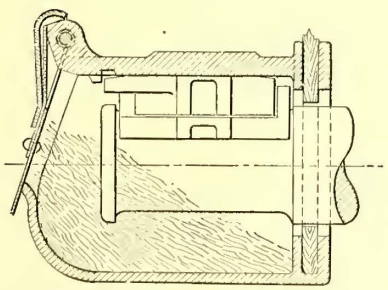
TYPE OF SATURATION TANK, WITH MOVABLE DRAINING TRAY, USED BY THE INTERBOROUGH RAPID TRANSIT COMPANY



PROPERLY PACKED JOURNAL BOX- showing packing in Three Portions.
1st The roll of packing at the back of box to aid the dust guard keeping the dust out and the oil in.
2nd. The packing between collars of journal, for its lubrication.
This packing should not extend above the center of the journal.
3rd - Plug in front of box to keep the packing between collars and Act as a dust guard
The separation between the packing in the front of the box, and that under the journal is very important it helping to keep the packing in place

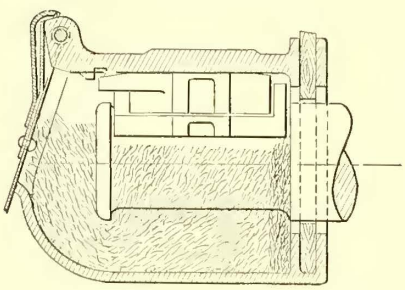


PROPERLY PACKED JOURNAL.-with packing away from journal, due to sagging of packing and wear of brass and journal.
Packing Iron is necessary to bring waste in contact with journal



EFFECT OF IMPROPERLY PACKED JOURNAL BOX.- no separation of packing
Back end of journal without oil, causing a majority of hot boxes
Packing Iron is necessary for good service in this case.

Street Railway Journal



TOO MUCH PACKING.- Packing liable to get under brass causing hot box.
It is also impossible to see defects in journal box, should any exist.

INSTRUCTIONS ISSUED FOR THE PROPER PACKING OF JOURNAL BOXES

equipment, who in turn sends a copy to the oil company's representative. The latter then figures out on loose leaf filing sheets the costs on all divisions, as follows: Motor car cost per 1000 car-miles, trail car cost per 1000 car-miles, and total cost per 1000 car-miles. A copy of the record, as given in the tables herewith, is then turned over to the railway company. This record affords a ready basis of comparison on the mileage cost of lubrication for both the subway and elevated equipment, besides showing how closely the actual expense approaches the guaranteed cost.

The ton-mile costs for different cars are of great interest in the contrasts they afford between motor and trail cars, on the one hand, and subway and elevated conditions on the other; for example, the average 1000-ton-mile lubrication

SUBWAY DIVISION, COMPLETE.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oil	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	2,058,943	1,218,487	3,277,430	3164	429	694½	216½	446	42	4992	$.46085	$.03614	$.30295
Feb.	1,848,630	1,099,434	2,948,064	2674½	637	748	381	266	20	4726½	.47642	.06618	.32343
Mar.	2,059,144	1,222,431	3,281,575	2283	531	346	199	241	9	3609	.33788	.03105	.22358
April	2,059,676	1,221,611	3,281,287	1920	563	332	148	315	18	3296	.31777	.02381	.20833
May	2,114,922	1,253,171	3,368,093	2693½	522	330	140½	303	0	3989	.36848	.02074	.23910
June	2,024,728	1,202,217	3,227,045	2136	504	265	130	370	0	3405	.33326	.02832	.21964
July	2,040,109	1,227,485	3,267,594	2060½	677	237	128	241½	0	3344	.33073	.01929	.21373
Aug.	2,074,913	1,250,366	3,325,279	1847	527½	685½	360	302½	0	3722½	.33251	.05326	.22751
Sept.	2,026,299	1,197,465	3,223,764	2262½	655	492½	323	544½	0	4277½	.40680	.04990	.27423
Oct.	2,166,618	1,288,022	3,454,640	2400½	550½	463	495	477½	0	4386½	.36871	.07109	.25774
Nov.	2,082,154	1,235,790	3,317,944	2174	589	371	404	280½	0	3818½	.33840	.06047	.23488
Dec.	2,199,813	1,310,442	3,510,255	2970	561	418	436	345½	0	4730½	.39452	.06155	.27021
Total	24,755,949	14,727,021	39,482,970	28585½	6746	5382½	3361	4304	89	48468	.38028	.04296	.24940

SUBWAY DIVISION, 148th STREET SHOP.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oil	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	.....	.....	.....	1539	294	204½	0	177	33	2247½	.....	.....	.....
Feb.	.....	.....	.....	1045	378	202	163	79	10	1877	.....	.....	.....
Mar.	.....	.....	.....	973½	306	....	9	....	10	1298½	.....	.....	.....
April	.....	.....	.....	614	320	32	18	78½	0	1062½	.....	.....	.....
May	.....	.....	.....	874½	278	0	0	53	0	1205	.....	.....	.....
June	.....	.....	.....	765	231	0	0	99	0	1095	.....	.....	.....
July	.....	.....	.....	500½	416	5	0	109	0	1025½	.....	.....	.....
Aug.	.....	.....	.....	202½	268½	0	0	79	0	550	.....	.....	.....
Sept.	.....	.....	.....	202½	268½	0	0	79	0	550	.....	.....	.....
Oct.	.....	.....	.....	506½	268½	0	0	200	0	975	.....	.....	.....
Nov.	.....	.....	.....	567½	256½	0	0	98½	0	922½	.....	.....	.....
Dec.	.....	.....	.....	1048½	250	0	0	148½	0	1447	.....	.....	.....
Total				8966	3603½	438½	190	1271	53	14522			

SUBWAY DIVISION, 137th STREET BARN.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oil	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	949,454	566,024	1,515,478	1700	179	383	87	280	31	2660	$.53521	$.03347	$.34781
Feb.	850,885	511,056	1,361,941	1627	312	431	203	136	15	2724	.55760	.07427	.37642
Mar.	947,105	569,333	1,516,438	1290	254	90	36	314½	5	1809½	.38025	.01269	.24226
April	961,125	573,819	1,534,944	1089½	249	95	40	194	10½	1678	.35104	.01514	.22547
May	993,999	594,092	1,588,091	1095	212	50	30½	170	0	1557½	.31408	.00949	.20013
June	950,482	569,796	1,520,278	1010	211	40	30	221	0	1512	.31982	.00974	.20367
July	955,126	582,171	1,537,297	1145½	305	37	43	298	0	1828½	.39142	.01367	.24837
Aug.	973,299	593,842	1,567,141	962½	236	260	230	137	0	1825½	.33455	.07165	.23493
Sept.	949,059	569,180	1,518,239	1111	306½	342	248	205½	0	2213	.42617	.08060	.29661
Oct.	1,015,011	610,152	1,625,163	1046	258	351	295	216½	0	2166½	.37719	.08943	.26916
Nov.	971,173	585,123	1,556,296	877	306	251	214	135½	0	1783½	.32033	.06766	.23176
Dec.	1,024,072	619,800	1,643,872	1228½	331	258	226	151½	0	2195	.39543	.06745	.27177
Total	11,540,790	6,944,388	18,485,178	14182	3159½	2588	1682½	2279½	61½	23953	.39478	.04482	.26277

SUBWAY DIVISION, 148th STREET BARN.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oil	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	1,109,489	652,463	1,761,952	1464	250	311½	129½	166	11	2332	$.39748	$.03802	$.26437
Feb.	997,745	588,378	1,586,123	1047½	325	317	178	130	5	2002½	.37628	.05596	.25746
Mar.	1,112,039	653,099	1,765,138	993	276½	256	163	106½	5	1800	.30193	.04703	.20762
April	1,098,551	647,792	1,746,343	830½	314	237	108	121	8	1618½	.28685	.03172	.19221
May	1,120,923	659,079	1,780,002	1598½	310	280	110	133	0	2431½	.41673	.03087	.27386
June	1,074,246	632,521	1,706,767	1126	293	225	100	149	0	1893	.34309	.02924	.22672
July	1,084,983	645,314	1,730,297	915	370½	200	85	114½	0	1685	.31224	.02437	.20488
Aug.	1,101,614	656,524	1,758,138	884½	292	425½	130	165½	0	1897½	.33076	.03663	.22092
Sept.	1,077,240	628,285	1,705,525	1151½	349	150½	75	339	0	2065	.38988	.02527	.25556
Oct.	1,151,607	677,870	1,829,477	1354½	292½	112	200	261	0	2220	.36123	.05458	.24925
Nov.	1,110,981	650,667	1,761,648	1297	283	120	190	145	0	2035	.33922	.05402	.23388
Dec.	1,175,741	890,643	2,066,384	1741½	230	160	210	194	0	2535½	.39371	.04362	.24228
Total	13,215,159	7,982,635	21,197,794	14403½	3585½	2794½	1678½	2024½	29	24515½	.35468	.03889	.23577

costs of subway motor cars are $.009885, of elevated motor cars, $.009415, of subway trailers, $.002777, and of elevated trailers, $.001921.

The general oiling of the cars is done every 10,000 miles or every tenth inspection, upon which occasion a red inspection card replaces the usual white card. The waste is then removed from the motor axles and the journal boxes. The boxes are repacked with old waste, but no oil is put directly into them. The absorption per journal for the larger cars is about four gills or .4 per 1000 car-miles or .01039 gill per 100 ton-miles.

The absence of hot journal boxes despite their lubrication only every 10,000 miles may be ascribed chiefly to the method of packing and the high grade of the oil and waste.

MANHATTAN DIVISION, 129th STREET BARN.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oil	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	777,063	505,825	1,282,888	339	46	65	40	214½	11	715½	$ .17358	$ .01630	$ .11181
Feb.	702,808	457,558	1,160,366	282	44	57	44	182	14	623	.17158	.02091	.11217
Mar.	782,643	511,587	1,294,230	495	76	106	61	217	14	969	.23853	.02427	.15384
April	766,532	502,045	1,268,577	397½	59	42½	65	204½	12	780½	.19365	.02621	.12738
May	792,658	518,520	1,311,178	304	123	102½	75½	267½	46	918½	.22776	.03793	.15269
June	767,249	503,256	1,270,505	425	162	157	131	247½	51	1173½	.28745	.06004	.19737
July	793,363	521,200	1,314,563	431	149	155	133½	244	23	1135½	.25252	.05285	.17351
Aug.	792,959	521,179	1,314,138	374	154	136	102½	207	10	983½	.22728	.03639	.15158
Sept.	758,808	495,488	1,254,296	396	176½	139	108½	200	13	1033	.24924	.04222	.16746
Oct.	814,930	534,917	1,349,847	388	155½	138	98	190	7	976½	.21868	.03495	.14587
Nov.	786,365	510,457	1,296,822	357½	138½	129	99½	201½	13	939	.21459	.03941	.14564
Dec.	820,676	540.744	1,361,420	399	110½	146	73	235	9	972⅓	.21732	.02498	.14092
Total	9.356,054	6,122,776	15,478,830	4588	1394	1373	1031½	2610½	223	11220	.21580	.03582	.14454

MANHATTAN DIVISION, 179th STREET BARN.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oil	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	952,408	678,938	1,631,346	676	82	270	181	210½	10½	1430	$ .26211	$ .05097	$ .17424
Feb.	856,262	606,481	1,462,743	631	73	212	110	83	3	1112	.22943	.03495	.14880
Mar.	959,419	678,761	1,638,180	737	89	326½	257	291	9	1709½	.30427	.07171	.20791
April	956,266	662,208	1,618,474	749	143	333½	226	168	15	1634½	.29630	.06528	.20117
May	989,236	685,218	1,674,454	710	143	236	137	184½	20	1430½	.26539	.04030	.17328
June	944,816	658,008	1,602,824	573	115½	238	157	147	13½	1244	.23246	.04477	.15603
July	967,864	671,199	1,639,063	608	148½	259½	145	190	8	1359	.24878	.04125	.16380
Aug.	977,751	677,280	1,655,031	697½	111	172½	114	287	½	1382½	.25785	.03113	.16507
Sept.	943,175	654,026	1,597,201	676	145	175	99	136	2	1233	.23817	.02801	.15205
Oct.	993,761	690,092	1,683,853	687	118	199	92	127	9	1232	.22385	.02631	.14289
Nov.	978,030	687,913	1,665,943	692	140½	143	71	226	10	1282½	.24328	.02061	.15133
Dec.	1,008,977	705,535	1,714,512	599	107	135½	118	175	9½	1144	.19967	.03094	.13024
Total	11,527,965	8,055,659	19,583,624	8035½	1415½	2700½	1707	2225	110	16193½	.24447	.04095	.16050

MANHATTAN DIVISION, 159th STREET BARN.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oil	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	1,575,387	781,034	2,356,421	865	120	190	110	315	18	1618	$ .19358	$ .02824	$ .13453
Feb.	1,416,970	689,426	2,106,396	854	133	109	82	325½	5	1508½	.19999	.02283	.14200
Mar.	1,585,323	773,818	2,359,141	1218	174	130	103	319	5	1949	.23634	.02535	.16713
April	1,548,986	765,628	2,314,614	1476	165½	114	76	388	0	2219½	.27921	.01836	.19293
May	1,587,948	787,360	2,375,308	2142	137	190½	170	436	16	3091⅓	.36265	.04211	.25640
June	1,507,710	739,793	2,247,503	1171½	148	40	37½	348½	12	1757⅓	.23238	.01092	.15503
July	1,562,133	761,449	2,323,582	1402½	272	158	87	542	0	2461½	.30214	.02114	.21010
Aug.	1,571,538	767,249	2,338,787	1433½	353	178½	104	573	0	2642	.32495	.02507	.22633
Sept.	1,500,007	739,390	2,239,397	1370½	300	164	95	500	0	2429½	.30791	.02377	.21410
Oct.	1,589,335	819,513	2,408,848	1235	265	145	87	363½	0	2095⅔	.25049	.01963	.17153
Nov.	1,509,364	928,604	2,437,968	1065	202½	115	65	282½	3½	1733⅓	.21797	.01325	.13999
Dec.	1,567,784	958,158	2,525,942	1265	110	157½	78	223	0	1833⅓	.20779	.01506	.13864
Total	18,522,485	9,511,422	28,033,907	15498	2380	1691½	1094½	4616	59½	25339⅓	.25532	.02128	.17592

MANHATTAN DIVISION, COMPLETE.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oi	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	3,304,859	1,965,796	5,270,655	1880	248	525	331	740	40	3764	$ .20960	$ .03260	$ .14358
Feb.	2,976,041	1,753,464	4,729,505	1767	246	378	236	590½	26	3243½	.20489	.02684	.13386
Mar.	3,327,386	1,964,166	5,291,552	2450	339	562½	421	827	28	4627½	.25647	.04110	.17653
April	3,271,785	1,929,880	5,201,665	2622½	368	490	367	760½	32	4640	.26441	.03695	.18002
May	3,369,842	1,991,098	5,360,940	3156	402½	529	386½	888	82½	5444½	.30249	.04056	.20521
June	3,219,776	1,901,056	5,120,832	2169½	425	435	325½	743	76	4174	.24591	.03557	.16783
July	3,323,360	1,953,848	5,277,208	2441½	569½	572½	365½	976	31½	4956½	.27500	.03625	.18859
Aug.	3,342,247	1,965,709	5,307,956	2505	618	487	320½	1067	10	5007⅓	.27750	.03016	.18778
Sept.	3,201,989	1,888,905	5,090,894	2442½	622	468	302½	836	15	4686	.27271	.03038	.18280
Oct.	3,398,027	2,044.521	5,442,548	2310	538	482	277	680½	16½	4304	.23506	.02590	.15648
Nov.	3,273,759	2,126,974	5,400,733	2114½	482	387	235½	710	26	3955	.22483	.02182	.14488
Dec.	3,397,437	2,204,436	5,601,873	2263	327	439	269	633	19	3950	.20898	.02374	.13609
Total	39,406,508	23,689,853	63,096,361	28121½	5185	5755	3837	9451½	402½	52752½	.24305	.03119	.16352

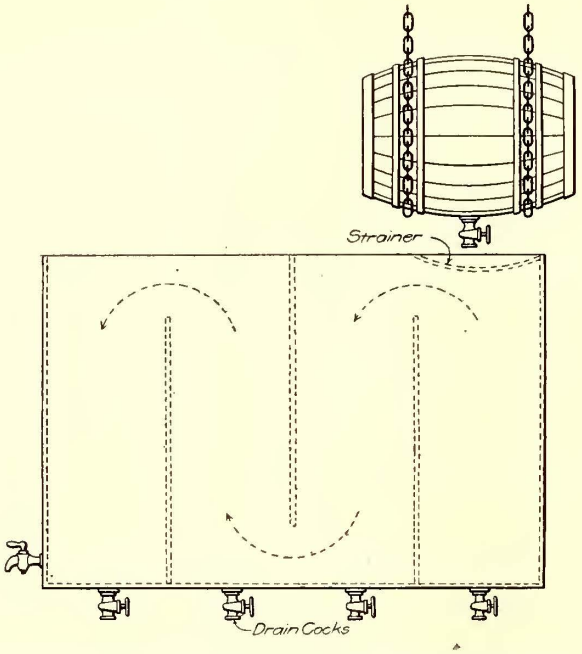
The pictorial instructions given on page 517 for packing journal boxes were devised by the Galena Signal Oil Company and are typical of the character of service it renders in helping to secure the best results. These instructions are placed in the shop in the form of blue prints and naturally are of great educational value.

The character of waste is also of importance; that used on the Interborough system is composed of the woolen refuse from a Brussels carpet mill. This waste has been found so satisfactory that it is used for three months in the motor bearings before its application in journal boxes. The glazed parts of the waste removed from the journals is thrown away, but the remainder is pulled apart and placed in a saturation tank. The tank, as shown in the view on page 517, has two sections, one being a saturation chamber in which the waste is allowed to absorb oil for 48 hours, and the other having a strainer where the waste is drained over night before it is used for repacking journal boxes.

The gears are lubricated with 4 lb. of gear grease at the 10,000-mile inspections, but for every 1000 miles run the pinion end armature bearings are given two gills of oil and the commutator end bearings one and one-half gills. These are equivalent respectively to .0519 and .0389 gills per ton-mile.

All armature bearings are drained every time a motor car is brought into the shop. The heavy part of this drip oil is retained for greasing drawbars, brake rigging, side bearings, sector bars and the like.

A great deal of attention has been given to the safe and convenient storage of lubricants, the company having built several fireproof buildings for this purpose. Of these the structure at the 159th Street elevated shop, illustrated herewith, is typical. This oil house has brick walls, a concrete roof, concrete basement floor and an upper floor composed of removable steel plates laid over steel beams. There is also a concrete unloading platform flush with the floor of the supply cars. The basement contains several tanks of 25-barrel capacity, all of which are piped together and controlled through a rotary pump placed on the upper floor. When a barrel of oil is received it is pumped through an opening in the upper floor directly into the top of the proper tank, to prevent the entrance of grit and dirt.



SKETCH OF OIL FILTER AT THE 148TH STREET SHOPS

MONTHLY REPORT FROM INSPECTION SHOP ON MATERIAL USED

Item	Stock		Used		On hand
Gelena Car Oil	Material on hand Oct. 1	340 gals.	Armature bearings.	735 gals.	
	Rec'd during Oct.	1503½ "	Cycle bearings.....	315 "	
			Journal trailer.....	200 "	
			Journal motor.....	112 "	
			Total.....	1362 gals.	481½ gals.
Wool Waste	On hand Oct. 1,'07	400 lbs.	Armature.....	70 lbs.	
	Rec'd during Oct.	511 "	Axles.....	150 "	
			Journals.....	200 "	
			Total.....	420 "	491 lbs.
Gear Grease	On hand Oct. 1,'07	750 lbs.			
	Rec'd during Oct.	1496 "	Gears.....	1125 lbs.	
			Total.....		1121 lbs.
Cotton Waste	On hand Oct. 1,'07	542 lbs.	Car cleaning	2000 lbs.	
	Rec'd during Oct.	1948 "	Shop use.....	300 "	
			Tail lamps.....	200 "	
			Total.....	2500 lbs.	None
Brake Shoes	On hand Oct. 1,'07	4309	Used in Insp. shop 148 lbs.....	3281	
	Rec'd during Oct.	6681	Used in rep. shop..	450	
			Used in Insp. shop 137 lbs.....	2300	
			Total.....	6031	4959
Compressor Oil	On hand Oct. 1,'07	134 gals.	Compressor.....	131 gals.	
	Rec'd during Oct.	100 "			
			Total.....	131 gals.	103 gals.
10-C.P. Lamps	On hand Oct. 1,'07	1450 gals.	Car lighting.....	3000 gals.	
	Rec'd during Oct..	2400 "	Shop lighting.....	500 "	
			Total.....	3500 gals.	350 gals
⅜-C.P. Lamps	On hand Oct. 1,'07	275			
	Rec'd during Oct..	0	Car lighting.....	245	
			Total.....	245	30
Kerosene Oil	On hand Oct. 1,'07	14 gals.	Tail lamps.....	360 gals.	
	Rec'd during Oct..	521½ "	Shop supplies.....	30 "	
			Transportat'n Dept.	45 "	
			Total.....	435 gals.	100 gals.

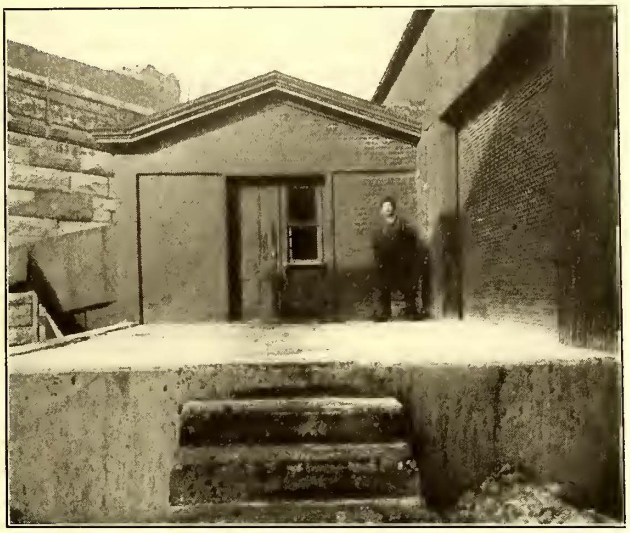
MANHATTAN DIVISION, 98th STREET SHOP.

1907	Motor Car Mileage	Trailer Car Mileage	Total Car Mileage	Motors		Motor Car Trucks Oil	Trailer Car Trucks Oil	Compressors Oil	Brake Rigging Oil	Total Oils Gallons	Motor Cars Cost per 1000 Miles	Trailer Cars Cost per 1000 Miles	Total Cost per 1000 Miles
				Oil	Grease								
Jan.	.....	.....	.....	362	124	40	0	26	7½	559½	.....	.....	.....
Feb.	.....	.....	.....	335	138	18	17	26½	11	545	.....	.....	.....
Mar.	.....	.....	.....	481	265	51	41	43	10	891	.....	.....	.....
April	.....	.....	.....	525½	265	57½	41	33½	21	943½	.....	.....	.....
May	.....	.....	.....	499	262	59	41½	35	38	934½	.....	.....	.....
June	.....	.....	.....	494	259½	55	47	37½	26½	919½	.....	.....	.....
July	.....	.....	.....	515½	305½	89½	37½	34	0	982	.....	.....	.....
Aug.	.....	.....	.....	470	321½	77	33½	22	0	924	.....	.....	.....
Sept.	.....	.....	.....	500	328½	72	45½	0	0	946	.....	.....	.....
Oct.	.....	.....	.....	540	228	51	38½	0	0	857½	.....	.....	.....
Nov.	.....	.....	.....	403	180	42	18	0	10	653	.....	.....	.....
Dec.	.....	.....	.....	382	117	39	24	30	0	592	.....	.....	.....
Total				5507	2794	651	384½	287½	124	9748			

The storage tanks are emptied by pumping from the top so that there is little chance for sediment to get into the oil. Different oil is used, of course, for winter and summer, but separate tanks are not required at any time, as no trouble has been experienced with mixed oils during the change-over periods. Special oils, such as for triple valves, are also kept in the oil house.

At the 159th Street plant oil recovered from used waste and drip cups is filtered through several layers of cheese-cloth, and is used again for lubricating journal bearings. The refuse is used for greasing drawbars, brake rigging, etc. The filter for this purpose at the 148th Street plant is more elaborate and has been found very effective.

As shown in the drawing on page 520, the filter consists of a steel tank, which is 4 ft. wide x 6 ft. long x 4 ft. high, divided into four chambers separated by steel plates. The oil to be filtered is stored in barrels which are emptied over a perforated brass plate fitted to the top of the first compartment to catch the coarser impurities. As this chamber fills up sediment drops to the bottom and the oil flows over the baffle plate into the second chamber, where there is a further settling of sediment. Since this process is repeated in each chamber the oil taken from the fourth compartment is found suitable for the purposes mentioned. In cold weather the oil in the first chamber is heated by a coil of piping carrying live steam. The sediment left at the bottom of the compartments can be quickly removed by opening the valve at the bottom of each, while the entire tank can be completely scoured after removing the top covering.



OIL HOUSE AND LOADING PLATFORM AT 159TH STREET INSPECTION SHOP

INTERIOR OF OIL HOUSE AT 159TH STREET INSPECTION SHOP

INSPECTION FORCE AT EACH SHOP

Air man—Blows out motors and other electrical apparatus.
Motor cleaner—Cleans and replaces brushes, and cleans brush holder leads and inside of motor.
Truck inspector—Inspects gears and truck bolts.
Motor inspector—Inspects all motors passing through the shop after being cleaned.
Wheel gager—Gages armature clearance and wheels.
Brakeman and helper—Inspects and adjusts brake apparatus and replaces shoes.
Pump cleaner—Cleans and oils air pump.
Pump inspector—Inspects pump after being cleaned, replaces brushes and sandpapers commutators when necessary.
Tripper and air hose man—Inspects air hose and tripper device for automatically stopping trains.
Controller man—Inspects master controller and master control switches and fuses.
Contactor man—Inspects contactors, motor rheostats, control rheostats, main and bus fuses.
Contact shoe man—Inspects shoes and shoe fuses.
Light and switchboard inspector.
Electrical inspector—Inspects motor leads, train line, general condition of wiring.
Electrical inspector—Inspects condition of control apparatus.
Armature oiler.
Drip collector—Drains drip cups under bearings and bleeds air tanks.

CAR HOUSE RATES

Classification.	Rates.				
Air Brake inspectors	$2.40	to	$2.60	per	Day
Air brake foremen	3.00			"	"
Air brakemen	2.25	"	2.40	"	"
Car inspectors	1.75	"	2.25	"	"
Controller inspectors	2.10			"	"
Electrical inspectors	2.15	"	2.65	"	"
Car house clerks	1.48	"	2.63	"	"
Car house foremen	3.62	"	3.95	"	"
Acting car house foremen	3.29			"	"
Assistant car house foremen	2.50	"	3.12	"	"
Car house helpers	1.90			"	"
Foreman lamp trimmers	2.00			"	"
Lamp trimmers	1.90			"	"
Motor inspectors	2.15	"	2.40	"	"
Storeroom tenders and car checkers	1.00	"	1.25	"	"
Foreman carpenter	2.90	"	3.00	"	"
Carpenters	2.65	"	2.75	"	"
Messengers	.50			"	"

SUB-DIVISION AND COST OF INSPECTION LABOR

The necessity for rapid yet thorough inspection requires the Interborough Rapid Transit Company to apply division of inspection labor to an elaborate extent. The accompanying list of the inspection force at the 148th Street shop is a typical example of this specialization. The men are now paid on the time system, according to the classification and rates given on this page.

Experiments are now being made by the department with a view to putting the inspection on a gang plan system which will put the men on a co-operative footing and reduce costs by the cutting out of idle time.

INSPECTION FOREMEN'S REPORTS

As noted in the article relating to the record system of the Car Equipment Department, the foremen of the inspection shops are not expected to keep any elaborate records. They forward to the main office daily all of the workmen's time cards; report of inspected cars and their mileage; report of train troubles; lamps replaced; flat wheels, etc. The inspection tags are sent in monthly. All of these forms are extremely simple, but they leave no doubt as to the responsibility for work done and when assembled in cleaning a car unsystematically as there is in inspecting a car before it has made a specified mileage. On the Interborough system definite periods are assigned for the various processes coming under the head of car sanitation and cleaning, which taken in connection with the record system make it practicable to avoid duplication of labor.

All cars are disinfected, swept and dusted every night The disinfectant is made of one gill 5 per cent carbolic solution to 5 gal. of water. Cotton waste is used for rubbing the inside work at these nightly cleanings. Floors are

DELAY TO SERVICE

129th Street Shop, January 15, 1908

Supt. Car Equipment.

Dear Sir:

Time, 9:36 a.m. from S. F. Place, 24th Street

Line, 3rd Avenue. Trouble, Loose jumper

Cause:

Train 417, 559, 205, Conductor McAdams. Motorman H. Peters, on arriving at 24th Street found a loose train line jumper between cars 417 and 559. Inserted jumper properly. Four minutes delay.

The above was caused by the jumper not being properly inserted.

Respectfully

FOREMAN

129th STREET BARN

New York, N. Y., Jan. 15, 1908

Supt. Car Equipment

Dear Sir:

I give you below report on condition of car No. 1200, received from 98th Street Shops on this date.

Car Body	OK.
Motor Truck	OK.
Trailer Truck	OK.
Whee's and Axles	OK.
Motors	OK.
Gears and Pinions	OK.
Contactors, Reversers and Controllers	OK.
Light and Heat Circuits	OK.
Air Compressors and Governors	OK.
Brakes	OK.
Coupler Sockets and Cables	OK.

TRAIN TROUBLES

129th Street Shop, January 15, 1908

Supt. Car Equipment.

Dear Sir:

Cars Nos. 374–622–1026–527–899

2nd Avenue Line, taken out of service at 129th Street.

Cause:

Above train arrived at 129th Street with hot armature on car 374. Train sent to barn.

Barn Inspector.

Car 374, found hot armature bearing on the pinion end, due to leaky oil well.

Respectfully

FOREMAN

CAR EQUIPMENT DEPARTMENT.

COPY OF MOTORMAN'S REPORT BOOK.

Date, January 15, '08

Car No.	Trouble	Repaired by
492	Leaky train line	Eberhart
500	Bad order door	Powers
694	Bad order governor	Powers
160	Blown main fuse	Eberhart

FOREMAN

INSPECTION AND REPAIR REPORT

129th Street Shop, January 15, 1908

Supt. Car Equipment.

Dear Sir:

I have to report the following, discovered while going over the cars for inspection:

Car 1566 reported for bad order pump.

Barn Inspector.

Found grounded armature and grounded brush holder, replaced same. Car OK.

Respectfully

CHAS. H. COLE,
FOREMAN

SOME INSPECTION SHOP FORMS OF THE INTERBOROUGH RAPID TRANSIT COMPANY

and analyzed at headquarters present a wide range of useful information regarding the work of the inspection shops and the apparatus in their charge.

CAR SANITATION AND CLEANING PRACTICE

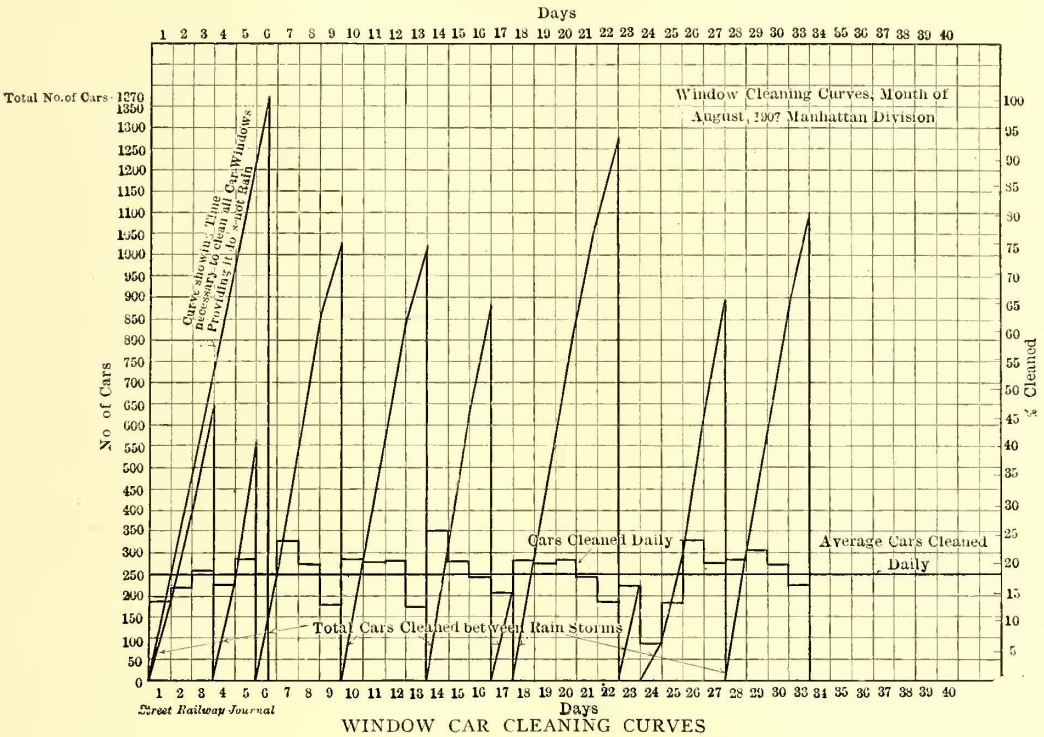
The same systematic study given to car inspection by the Car Equipment Department has been applied to car cleaning, and rightly, for the fact that the cleaning cost of a car is more than half that of inspection shows what a big factor it is in the expense of keeping up rolling stock. It is just as essential, therefore, to avoid needless expense scrubbed every 15 days, the cane seats removed and scrubbed every three months, hand straps are cleaned with oxalic acid every 30 days and the exterior car woodwork cleaned every four months with a special cleaner.

The costliest branch of this work, however, is the cleaning of the car windows. This is carried out in accordance with a system whereby all cars in service would be cleaned regularly at intervals of four days provided it did not rain. Should storms occur, however, it is necessary to begin all over again on the assumption that every car needs attention. This scheme appears graphically in the window

cleaning curve on this page, which shows how many cars were cleaned between rainstorms during August, 1907, on the Manhattan division, giving also the number of cars cleaned every day in the month and the monthly average per diem.

CAR CLEANING MATERIAL

The materials used for car cleaning are of the simplest and have all been analyzed by the department to avoid paying high prices for old standbys with fancy titles. In one instance analysis demonstrated that a car cleaning compound for which $2 per gallon was demanded could be secured in New York for just one-eighth that figure. Floors are scrubbed with a soft soap solution; price of soap powder $.05225 per lb. The windows are cleaned with whiting and powdered pumice stone; price of whiting



WINDOW CAR CLEANING CURVES

$.002/3 per lb. and pumice stone $.175 per lb. Exteriors are cleaned with a car cleaner costing $1 per gallon.

PAYING FOR CAR CLEANING LABOR

Since Nov. 15, 1906, all elevated car cleaning except sweeping and the cleaning of hand straps has been put on a piecework basis. Most of the subway cleaning is done by the day system. The average wages for 10 hours on the day system are $1.70 for laborers, $2 for assistant foremen and $2 to $2.75 for the foremen. The piecework rates per car are as follows: Floor mopping, $.135; window cleaning, $.125, and exterior cleaning, $1.15. The introduction of the latter system has worked beneficially both ways; the average earnings of the men having increased while the company has secured a reduction from $.143 per car a day to $.125 per car a day. In window cleaning, for example, one man cared for six cars when paid daily wages to-day 16 cars, with 36 windows each, are handled by one cleaner at $.125 per car, or a net daily wage of $2. The monthly costs at different inspection points were reproduced in the article describing the record system of the car equipment department.

All of this work except the nightly cleaning is done at the inspection shops under a car cleaning foreman, who reports to the local inspection foreman. The general inspection foreman also has a car cleaning inspector who visits the different shops for the purpose of detecting poor work and otherwise seeing that the car cleaning throughout the system is maintained at the desired standard of excellence.

ENGAGING MEN FOR INSPECTION AND CAR CLEANING

The employment of men for the car equipment department is conducted on a system which gives the head of the department the chance to look over every applicant and at the same time leave the greater part of this work to the foremen themselves. This is done by setting every Friday afternoon apart for the hiring of men at the Ninety-eighth Street office. Here all the foremen assembled as a board of employment in the presence of the superintendent examine every man who applies for a position. Most of the men accepted are chosen directly by the foremen, but if the superintendent believes that some man has not received a fair hearing the foremen must explain why they object to the candidate.

This practice has been found very beneficial in several ways. It does not restrict the liberty of a foreman to pick the kind of men he wants, but, on the contrary, he is helped by the advice of his fellow-foremen, who also may prevent a man discharged on one division applying for work on another under an assumed name. To the superintendent this method is valuable in saving his time, giving him a line on the executive ability of his assistants and in eliminating as much as possible the hurtful influences often brought to bear in the employment of men. Everything must be done in the light of open day and naturally the standard of efficiency rises as the opportunity for favoritism is reduced.

MAINTENANCE AND REPAIR SHOP PRACTICE

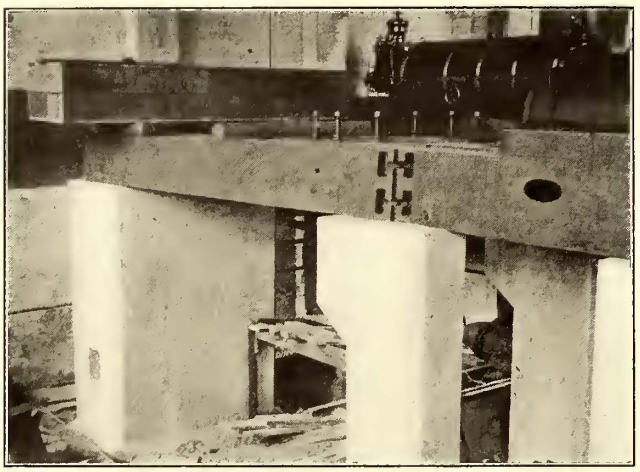
The next article will take up the maintenance and repair practice of this company as applied on both divisions.

NEW OIL CUP USED BY THE WEST PENN COMPANY

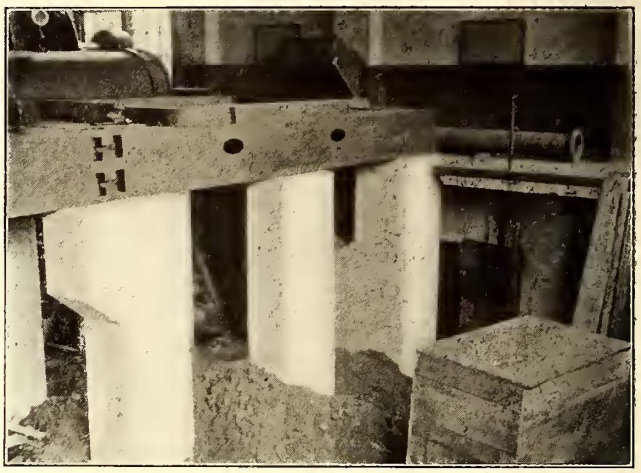
In adapting to oil lubrication motors built for grease the West Penn Railways Company has used for the past few years a cup with a wick feed and a ball valve underneath. An objectionable feature of this cup, however, has been that the ball would stick to its seat and of course stop the flow of oil. The company is now using with much success a plain cup with two strings of wick extending from the bottom of the cup over the top and down the side. The strings are brought out of a small wadded bunch of wick placed at the bottom of the coil. The cup is somewhat smaller than the grease box of the motor and is packed into the box with waste on all sides. The oil from the inside of the box passes through the two wick strings and keeps the waste outside the cup saturated to the right degree.

POWER STATION IMPROVEMENTS, ORIGINAL DEVICES AND IDEAS IN THE WEST PENN STATION AT CONNELLSVILLE, PA.

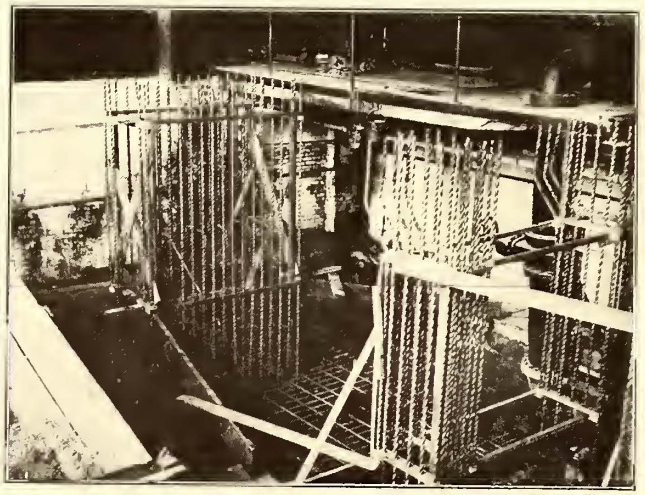
Extensive improvements and additions are being made to the generating station of the West Penn Railway Company at Connellsville, Pa., from which is operated the interurban railway system of more than 150 miles, connecting Pittsburg, McKeesport, Connellsville and other cities in the coke producing district southeast of Pittsburg, and which in addition furnishes power to operate mines and factories in the coke region and to light many of the cities connected by the railroad, thus serving a population of about 300,000. The original station, which was described in the STREET RAILWAY JOURNAL Sept. 5, 1903, contained three 1000-kw a. c. generators connected to Allis-Chalmers vertical Corliss cross-compound units and three 1000-kw turbo-generators. The additions have been necessitated partly by the extension of the railway and power system and partly by the shutting down of 16 central station plants which previously served the railway and lighting properties.



GENERATOR END PIERS IN WEST PENN RAILWAY COMPANY'S POWER HOUSE



STEAM END PIERS IN WEST PENN RAILWAY COMPANY'S POWER HOUSE



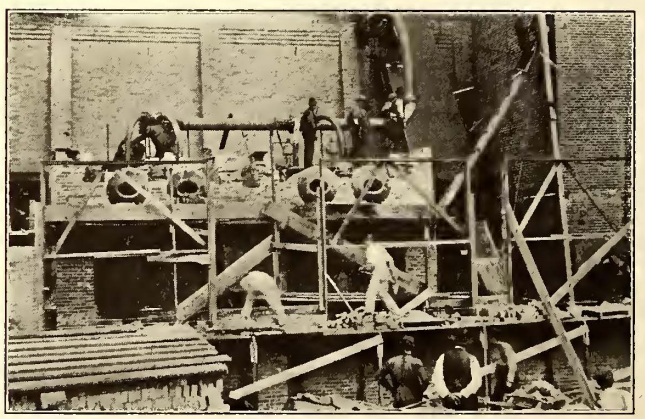
REINFORCEMENT OF PIERS IN WEST PENN RAILWAY COMPANY'S POWER HOUSE

The improvements made have consisted of the installation of a 3250-kw Westinghouse turbine with necessary condensing apparatus and the installation of ten 400-hp Bonus-Freeman water tube boilers. The two boilers already installed and eight additional ones will be placed in a row parallel to and facing the old boilers, and they will be enclosed in an extension to the present boiler house which will contain overhead bunkers of 1600 tons capacity.

The plans contemplate a general overhauling of the switchboard apparatus and the installation of remote control high-tension switches built by the Hartman Circuit Breaker Company. These remote control switches will replace "stick type" switches located in a high-tension structure detached from the power house proper. Outside the station considerable work is being done in rebuilding a condensing water intake which will obviate troubles due to ashes carried down stream from coal mines and power plants above. The point of particular interest in connection with the new work is that original ideas of the engineering staff of the system headed by W. E. Moore, formerly general manager and now consulting engineer, are being employed in preference to the adoption of customary methods and standard apparatus. Almost every detail of the work has incorporated in it some of these new ideas.

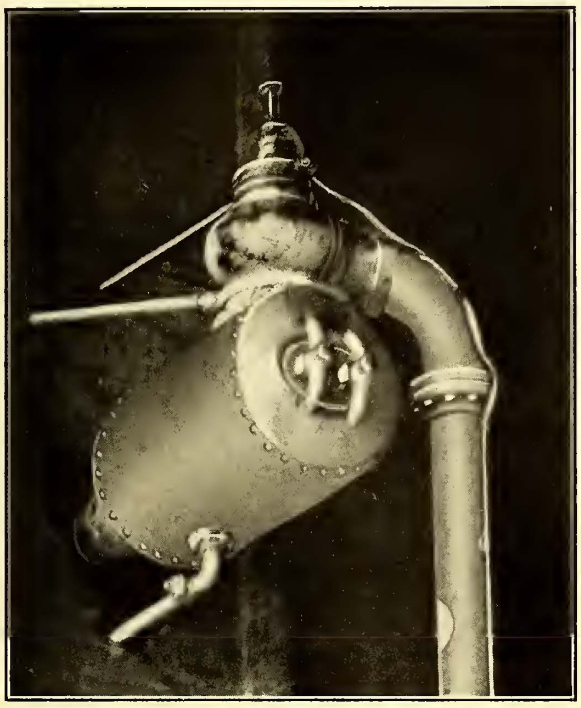
THE TURBINE INSTALLATION

In order to utilize the much needed space underneath it the new turbine was installed on reinforced concrete piers, as shown in the engravings. The bed from which the piers project, as well as the piers themselves, are heavily reinforced with twisted steel rods. At the generator end there is a 9 ft. 4 in. x 3 ft. solid pier and at the steam end a twin pier 4 ft. x 8 ft. in cross section having an opening near the top through which the free exhaust passes. The two sets of intermediate piers are each 2 in. x 3 in. in



SHOWING METHOD OF Y CONNECTIONS TO STEAM DRUMS

cross section. Installed directly under the turbine is a Wheeler surface condenser with 10,000 sq. ft. of condensing surface, to which water is supplied by a 20-in. centrifugal pump driven by a Westinghouse compound engine. The engine and pump are located on opposite sides of the



HORIZONTAL STEAM SEPARATOR

steam end turbine pier and the shaft passes through this pier.

VALVE IN ENGINE EXHAUST

An accompanying drawing shows a cross section of the 42-in. valve and elbow between the turbine exhaust and the condenser. This elbow and its parts were designed by the company and were built in a local foundry and machine shop. The atmospheric relief valve just above the gate valve is pivoted on a crank and is provided with gasket seat. The cost of the elbow and parts, approximately $1,350, was much less than the cost of using standard valves and fittings, and the elbow makes a much more compact arrangement.

THE BOILER FEED PUMP.

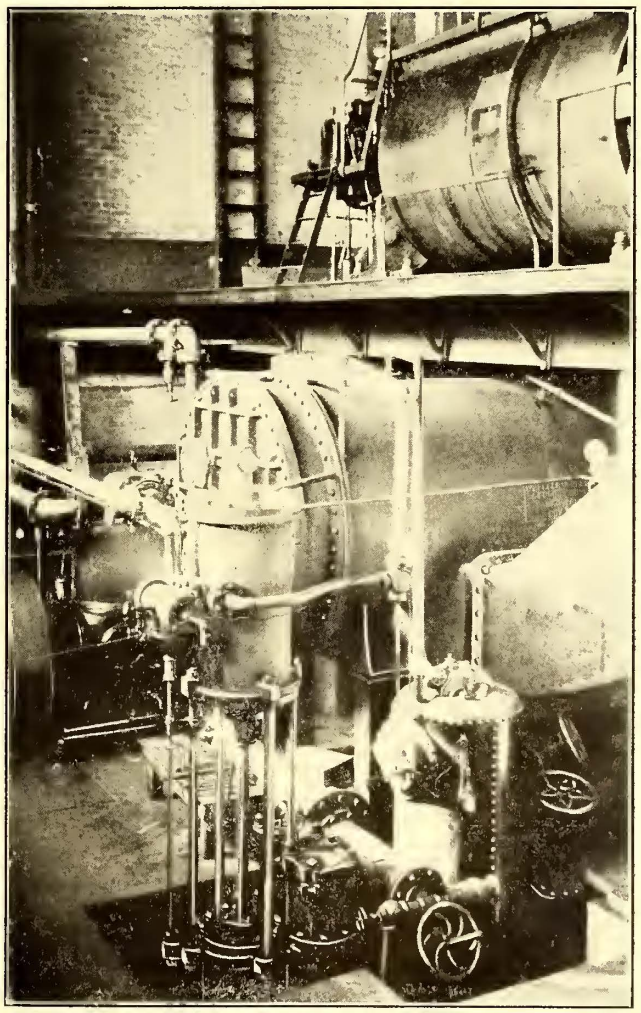
Probably the most extraordinary feature in connection with the condensers installation is that the hot well pump is dispensed with. In its place a specially designed boiler feed pump is used to draw the water from the vacuum in the hot well and force it into the boilers. The pump was designed by the engineering department of the railway company and was built by Boyts, Porter & Co., of Connellsville, Pa. It is of the admiralty pattern with cylinders 18 in. x 12 in. x 34 in. The pump is designed with no dead spaces in which air may become trapped. The stuffing box for the water cylinder is of the double seal type and is 14 in. deep. Dunbar metallic packing is used on the water plunger. The pump is set with the water cylinder below the floor level, and in anticipation of this it was designed so that no parts requiring attention or adjustment are below the floor level. The steam supply pipe is taken off the bottom of an auxiliary engine supply pipe. The connection serves as a drip main for the auxiliary engine supply, while the moist steam does not affect to any extent the action of the pump. The supply of steam to the pump is automatically controlled by a floating valve in the hot well.

SPRAY BOX

Make up water is injected into, and the dry vacuum pump is connected to, a cast-iron "spray box," approximately 4 ft. 6 in. long and 18 in. square, located over the condenser, into which box the water is introduced through a 4½-in. pipe perforated with ¼-in. holes. The vacuum pump connection is made through a 10-in. pipe leading out of the top of the box protected by a baffle which prevents water getting into the air pumps. The effect of introducing the water at this point is to cool the air and thereby lessen the work of the vacuum pump. At the same time the make-up water is heated by the condenser to 100 deg. before being pumped through the feed water heaters to the boilers.

STEAM SEPARATOR

The tendency of water to be thrown out against and flow along the walls of a pipe in a steam line has been taken advantage of in the construction of a separator for the new turbine of somewhat novel form. It is a small horizontal



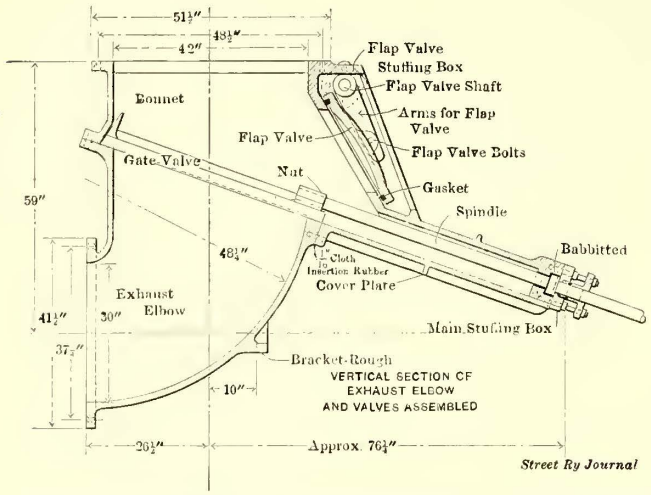
TURBINE AUXILIARIES AND SPECIALLY DESIGNED PUMP

drum placed on the end of the steam pipe on the engine room side of the boiler room wall. The pipe is brought to the diameter of the drum by a gradual enlargement or trumpet shaped head on one end of the drum. The turbine supply pipe is taken off the top of the opposite end of the drum. A hand hole is provided at the end for examining

the interior of the drum. This separator is reported as giving unusually dry steam.

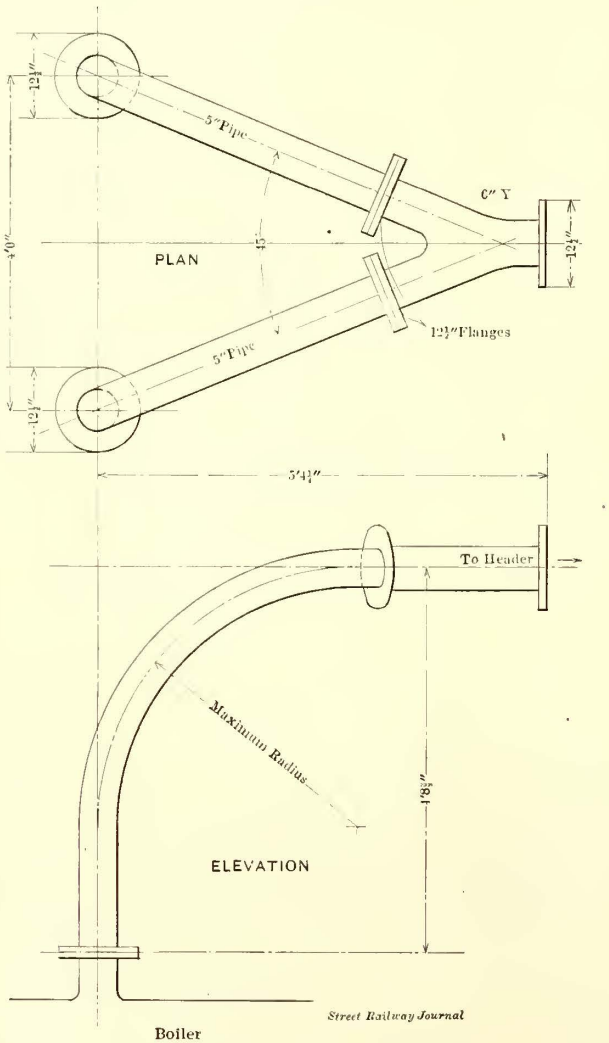
ROTARY CONVERTER BRUSHES

The rotary converters in the station are provided with



EXHAUST ELBOW AND VALVE BOX FOR 3250-KW TURBINE

brush holders designed by the company's engineering department. The slots are not interrupted by bridges, but extend the full width of the holder. The springs are of the clock spring type. The shunts are screwed in ordinary telegraph binding posts secured in the holders. All screws for adjusting the brushes are where they can easily be reached and are protected from arcing by a heavy plate. The arm to which the holder is attached is slotted and the holder is secured in such a manner that it can be removed by simply loosening two nuts.

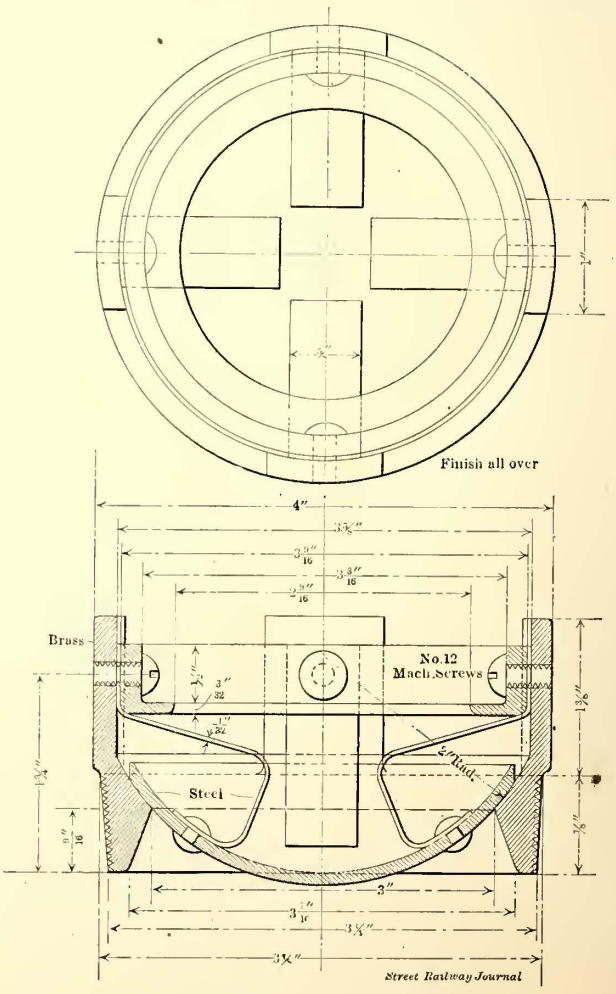


BOILER PIPES

CONDENSER INTAKE CRIB

Last spring during the high water in the Youghiogheny River, from which the condenser water supply is taken, the condenser intake and discharge outlets were covered with ashes and sediment to such an extent that it was necessary to shut the plant down for a few hours. To prevent a recurrence of the same trouble about $17,000 is being spent in building a concrete crib wall between the river and the power station containing intake wells and gates. At its south end the wall protects a railway embankment. It then curves around at right angles and becomes a crib wall. Behind it are four outside sump chambers and behind these are four inside chambers. Each chamber measures 30 ft. x 16 ft. and all walls are of reinforced concrete. The outside wall will contain 22 screens and gates arranged at three heights so that by opening and closing the gates protecting the individual screens water can be taken from the surface of the stream at different stages. This is very desirable because of the ashes carried in the undertow.

The screens are of cast-iron with bars parallel to the current of the river and measure 6 ft. x 4 ft. and are set flush with the outside surface of the wall. Behind each is a 2 ft. x 4 ft. gate which sets in the wall and is controlled by a hand wheel mounted on a cast-iron stand above. Finer screens are placed in the dividing walls between the

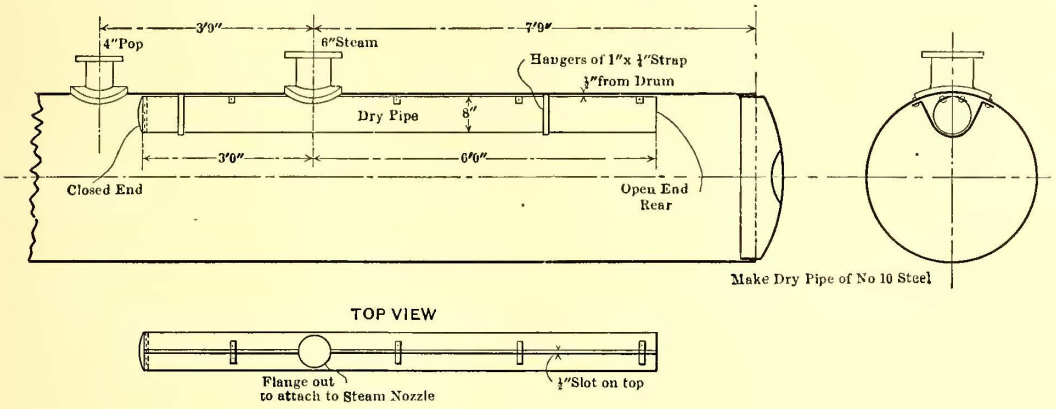


VACUUM PUMP DISCHARGE VALVE

inside and outside sump chambers. The openings leading from the inside chambers to the intake pipes and the intermediate screens are all provided with gates so that it is possible to close any one of the sump chambers for cleaning and bypass the water.

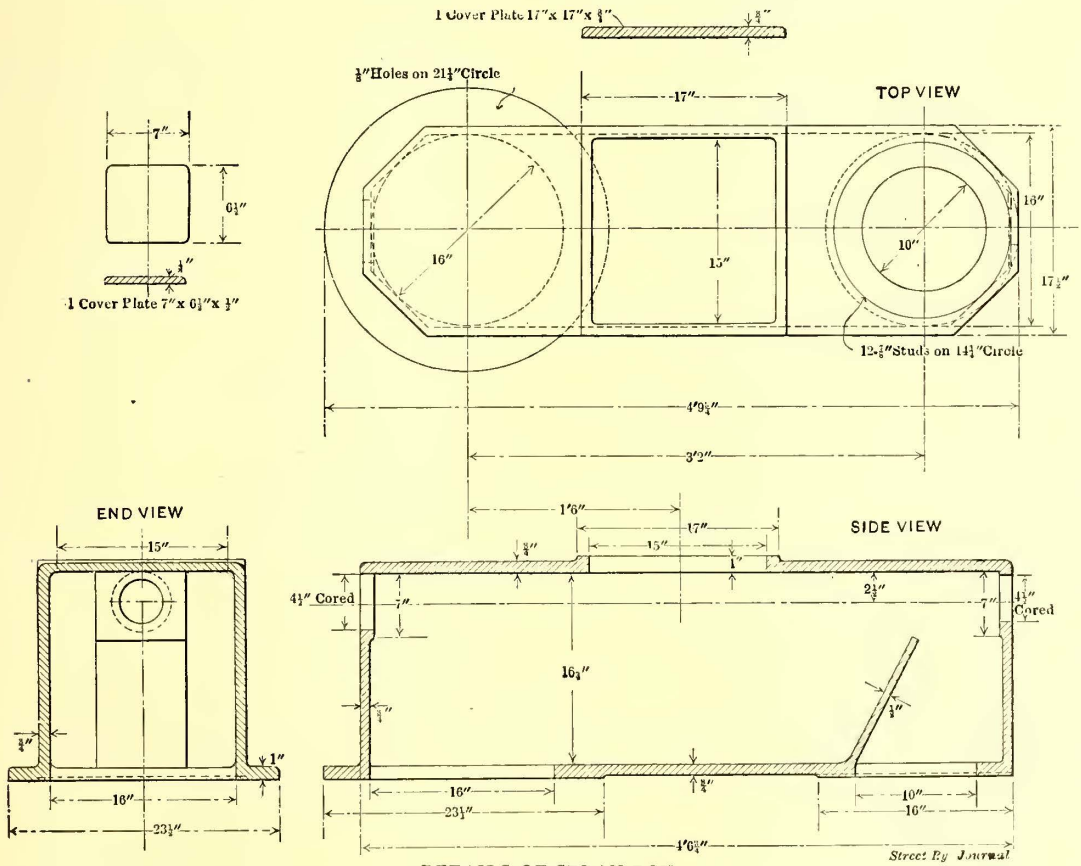
FLUSHING THE CONDENSER INTAKE

In some recent installations where silt and solid matter



DRY PIPE USED IN BOILERS

are deposited in the condenser intake, extra pumps placed in valve controlled direct connections between the intake and the discharge pipe at the station end are used to flush



DETAILS OF SPRAY BOX

the intake. The plan adopted in this installation was to cut two 10 in. x 14 in. openings in the baffle of the Wheeler condenser. When the wood plugs with which the openings are usually closed are removed and the 20-in. centrifugal pump is driven at more than normal speed, a free flow of water bypasses the condenser tubes and the excessive current through the pipes washes them out without danger of clogging the condenser tubes with silt.

VACUUM PUMP DISCHARGE VALVE

A special vacuum pump discharge valve has been designed by the engineering department and is in use on the vacuum pumps in the station. The principal features of the valve are shown in an accompanying drawing The valve itself is a section of a sphere and is held in place by four springs. The design cuts down clearance to a minimum and as the springs act as guides there is little possibility of the valve not seating properly. Moreover, as the valve is spherical it makes a tight seat even with considerable variation in its position. An additional advantage is that the moving element is very light. The cost of the valve is about half that of the standard type.

THE NEW BOILER INSTALLATION

The boilers were built by the Bonus-Freeman Company, of Racine, Wis. They are of 400-hp capacity and are erected in batteries of two boilers. Each boiler is provided with a 9 ft. x 7 ft. Murphy stoker and smokeless furnace set underneath. The furnace hoppers will be supplied with coal from the bunkers overhead through chutes.

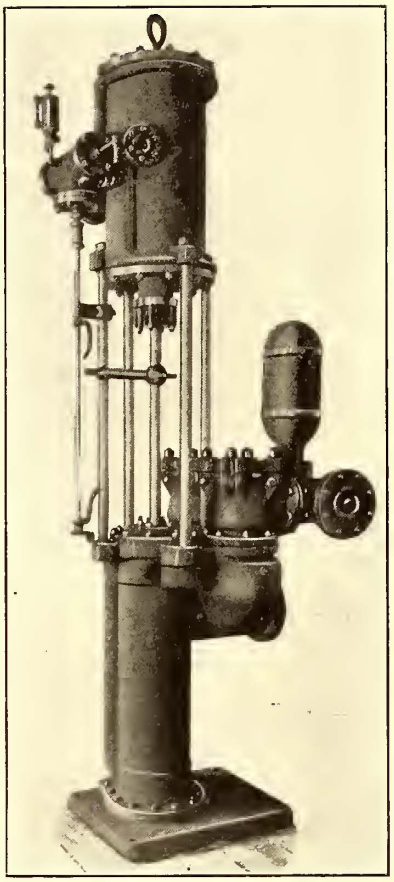
BOILER FOUNDATION

As the underlying soil is soft and spongy more than the usual attention was given to the boiler foundations. A solid reinforced concrete mat 1 ft. thick extends under the five batteries of boilers. A similar mat will be built under the other two batteries. The reinforcement in the mat consists of old ¾-in. and 1¼-in. mine haulage cables which were obtained from the coal mines in the neighborhood at a comparatively low cost.

CONCRETE FLUES

Flue gases for the entire boiler installation are lead into two stacks which serve the old boilers. Instead of the customary sheet iron flues extending from the uptakes of the boilers to the stack, reinforced concrete flues are used in

connection with the new boiler installation. The cost of the concrete flue built was about three-fifths that of a similar sheet iron flue. The design was decided upon after repeated tests to determine the heat resistance of the reinforced concrete. These tests were carried on by E. W. Scheidelhelm, construction engineer, and showed that concrete made of Portland cement and crete made of Portland cement and good rock low in lime and mixed in the proportions one, two and three, had the best heat resisting qualities.



PUMP DESIGNED BY THE ENGINEERS OF THE WEST PENN RAILWAY

The flue walls are 4½ in. thick and the chimney opening is 9 ft. 10 in. x 10 ft. 3½ in. in cross section. It is reinforced with expanded metal of No. 10 gage and 3-in. mesh. One side is formed by the brick wall of the building, and for protection to the wall this side is lined with fire brick. The other side and the top and bottom are unlined. The flue is supported on reinforced concrete lintels 18 in. wide and 12 in. deep, carried by the building wall and the boiler setting. Between lintels the building wall is corbeled out to support the flue.

MAKING OPENINGS INTO THE STACKS

Before building the flue the stack opening was cut to the 4-in. lining. After completion this lining was removed and the opening to the stack made without throwing out of service the old boilers connected to the stack. It was found that the draft through an opening left purposely in the concrete flue protected the man inside of it when cutting the lining away.

FLUE DAMPER

Provision for the support of the sheet iron damper in the concrete flue is rather novel. The axis is vertical and the damper is supported by a chain attached to the roof overhead. A turnbuckle in the chain permits of adjustment. A crank for operating the damper is located on the lower end of the axis.

BOILER DRY PIPES

Experiments with the old boilers resulted in the adoption of an inexpensive but efficient dry pipe for the new ones. The pipe consists simply of a sheet of No. 10 steel 9 ft. long rolled to an 8-in. circle. The edges are left ½ in. distant from each other and are held in position by straps. The front end of the pipe is closed with a head, but the rear end is left open. The pipe is secured under the 6-in. steam outlet with the narrow slot uppermost by two straps riveted through the boiler plate.

BLOW-OFF PIPES

The new boilers are provided with three sets of blow-off pipes, one at the boiler feed pipe mud drum, one at the surface of the water and one at the bottom of the rear water leg of the boiler. These provisions for blowing off resulted from the beneficial effects of blowing off the old boilers at frequent intervals. The arrangement of the blow-off pipe at the boiler feed is of particular interest. The boiler feed pipe projects into the boiler for a considerable distance and into a larger pipe secured to the rear head at the center of this large pipe. The feed water passes out the end of the small pipe and is then compelled to flow back through the larger pipe. Before passing from this pipe it becomes heated and many of the scale forming ingredients are precipitated. The current produced in the larger pipe when the blow-off cock is opened tends to carry the deposit out. All of the blow-off pipes lead into one header located behind the boilers.

CONNECTIONS BETWEEN STEAM DRUMS

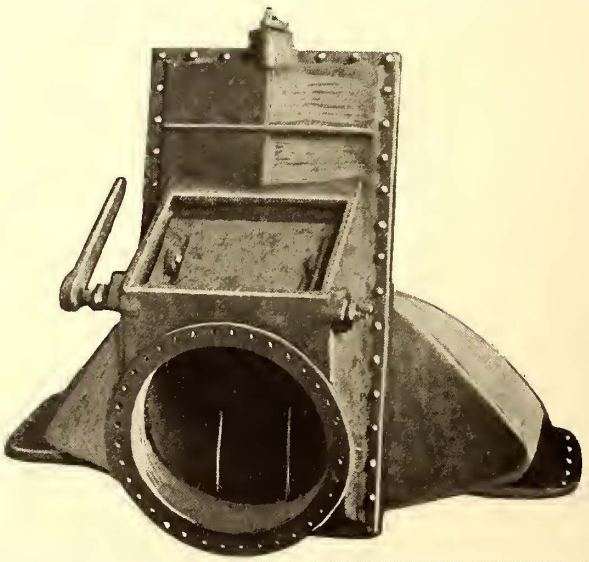
The steam drums of the old boilers have rigid bridge-pipe connections and trouble has been occasioned because these connections do not allow for expansion and contraction of the boilers. To obviate this the two steam drums of each of the new boilers are joined to the main header through a Y connection, as shown in an accompanying drawing.

FEED WATER HEATERS

In connection with the new boilers a 3000-hp Wainright even-flow feed water heater has been installed. All feed pipes to the new boilers are of brass and are provided with Berry automatic boiler feed controllers.

DRIP SYSTEM

All steam mains are drained back to the boiler through drip mains provided with ordinary swing check valves.



SPECIALLY DESIGNED CONNECTION BETWEEN TURBINE AND CONDENSER VALVE AND ATMOSPHERIC RELIEF VALVE

The pulsations of the turbine governor it has been found produce sufficient variations of pressure in the pipes to operate the valves and permit drip to flow back into the boilers automatically.

HOME-MADE OIL

All the oil used in the plant is made from crude stock purchased in carload lots, which is stored in tanks outside

the building and mixed and boiled as consumption necessitates. The difference between the cost of making the oil and of buying the proprietary brands has resulted in a considerable saving in the station oil bill. No trouble whatever has been experienced in the use of the home-made product, and the appearance of the bearings and cylinders is such as to prove conclusively its adaptability to the service.

REPEATED USE OF WIPING RAGS

Rags for wiping the machinery are used over and over about 10 times. The original cost of the rags is about 2½ cents a pound, but the repeated use brings the cost to about one-tenth this amount. In cleaning the rags all surplus oil is removed in about five minutes by means of a centrifugal wringer. The rags are then boiled in a tank supplied with live steam for about two hours, after which they are wrung again and placed in a drying oven. The oil removed is used in lubricating the coal conveying apparatus. The oven is of brick and is constructed with racks, similar to those found in steam laundries, which may be pulled out. The oils are stored and treated and the rags cleaned in a fireproof room in an extension from the plant proper.

HANDLING OIL

The station is provided with a central oiling system with the filters located in the basement. Instead of using the customary oil pump, the oil is raised from the storage tanks in the basement to the elevated tanks by compressed air. When the tanks are full the air is simply let in the top and the oil is forced out the bottom and up through the pipe line into the overhead tank.

DRAWINGS OF APPARATUS

It is the practice of the company to hang on the walls of the engine room general drawings in frames and behind glass of the apparatus in use. In addition to being in position for ready reference they add materially to the appearance of the room.

All of the work in connection with the power house extension was planned in the company's offices at Connellsville, and is being executed by its engineering staff, there being practically no work let to contractors. W. E. Moore, formerly general manager of the system, who was recently succeeded by Geo. R. Folds, has had general supervision of the work in the capacity of consulting engineer of the company, with headquarters at Pittsburg. The details have been worked out by the engineering department, consisting of J. S. Jenks, electrical engineer; J. L. Fritsch, civil engineer; F. W. Scheidelhelm, engineer of construction; F. F. Espenschied, Jr., engineer of tests and installation, and J. L. Lawrence, engineer of power station, to whom was intrusted the execution of the work.

PNEUMATIC PRESSURE FOR GENERATOR BRUSHES

An English manufacturer of carbon brushes has brought out a brush holder for turbo-generators in which compressed air is used for maintaining the brush presure. The brush is attached to a brass piston which moves in a cylinder, the pressure upon the piston being applied through a rubber cap or bag which surrounds the end of the air supply pipe. The pressure, which is about 3 lb. per sq. in., is secured initially by a foot pump and is afterwards maintained by a weighted cylinder. Satisfactory results are said to have been secured on small turbo-generators running at 2500 to 3500 r.p.m.

AXLE BEARINGS AND COLLARS

BY JOHN HEWES

Two of the most important features of care incident to successful mechanical maintenance of electric car equipment are the prompt renewal or adjustment of axle collars and timely replacement of axle bearings. Failure to observe the maintenance demands of these two devices is to a great extent responsible for unnatural noises in operation and slow but sure reactionary deterioration of dependent parts of the equipment. To be specific: The gear on one side of the motor and the axle collar on the other are supposed to keep the motor in a central, neutral position in which the gear and pinion are in perfect alignment. This implies a suspension rigging so installed as to eliminate all stresses tending to force the motor to one side or the other on the axle when the car is on straight rail; otherwise there will be on the axle collar and its engaging axle bearing or on the gear hub face and its engaging axle bearing a constant thrust to increase the wear of these parts. In a measure, as any of these parts wear, end-play of the motor on the axle is introduced; and in a comparatively short time, where steady side thrusts exist, the gear is rubbed on one side or the other by the gear case. This causes the familiar noise attributed to "gear case rubbing." If this condition is permitted to persist it will eventually result in the side of the gear case being milled out by the gear just as it may be milled out by the pinion where armature end-play is excessive. Motor end-play, due to axle collar wear, is easily remedied by putting on a wider collar, or, in the case of an adjustable collar, by letting out on the set screws, provided they have not rusted tight from want of attention When the play is on the gear end, if the shoulder of a new axle bearing is not sufficiently thick to take up the excess clearance, the shoulder can be babbited to the desired thickness.

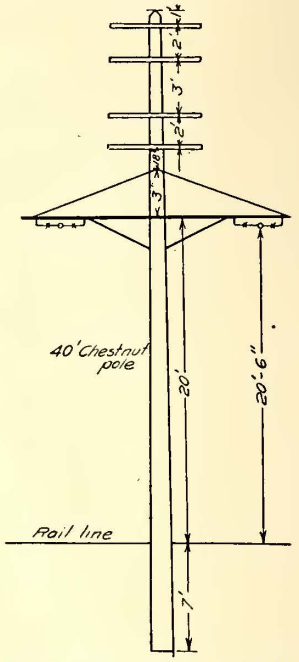
Excessive wear in the axle bearings has several effects. Wear in the gear-end bearing alone permits the pinion end of the motor to pull away from the axle around the commutator-end axle bearing as a center. This impairs the efficiency of the gearing because it changes the distance between the gear and pinion centers and causes the teeth of the pinion and gear, especially the former, to wear to a knife edge on one end while the wear on the other end may be comparatively slight. Excessive wear in both axle bearings permits the motor to raise bodily when the car is started in a certain direction. In the case of "choppy" service the result is numerous heavy blows delivered by the motor to itself and to the axle and a well-defined tendency to loosen bolts and otherwise create trouble.

Axle-bearing wear is initially upward, approximately opposite to the downward direction in which the weight acts. As soon as wear obtains, however, the motor takes on at starting a sort of gyrating motion. The axle then not only rotates in the bearing space, but the motor journal box tends to revolve around the axle. The result of this motion is to enlarge the axle bearing laterally much after the manner that a dentist enlarges a cavity with a drill. The final result is greatly to increase the distance between the centers of the pinion and gear so that the pinion-teeth and gear teeth engage each other only on comparatively small surfaces near their apices. This condition in turn increases the intensity of the forces transmitted by the teeth and decreases their lives proportionately. With excessively worn axle bearings long before the gear and pinion teeth will have reached a condition of unnatural wear necessitating their removal noises will plainly herald existing and approaching unnatural conditions.

RECONSTRUCTION OF THE MEMPHIS STREET RAILWAY SYSTEM

Immediately after the Memphis Street Railway Company was acquired by new interests in February, 1905, the work of reconstructing the entire system was begun. The work has been in progress steadily since April, 1905, and although not entirely completed during this time, 30 miles of track and overhead line have either been constructed or reconstructed, an addition to the power house containing a 2000-hp engine has been built, and a new car barn with a capacity of 150 cars has been erected.

GENERAL VIEW OF FINISHED WORK AT MAIN AND MADISON STREETS, MEMPHIS



JOINT CONSTRUCTION BY RAILWAY AND ELECTRIC COMPANIES. COST, 50% PRO RATA ON POLE, MATERIAL AND LABOR ONLY

TRACK WORK

The track construction varies in paved and unpaved streets and on private right of way. That built in asphalted streets has 8 ins. of broken stone under the ties, and a 12-in. bed of concrete, between and above them. This concrete bed extends 5 ins. to 6 ins. outside of the ends of the ties. The concrete is covered with a 1½-in. layer of binder, and on this is laid 3 ins. of asphalt. With this construction a standard 109-lb. Trilby rail in 60-ft. lengths is used. The ties are 6 ins. x 8 ins. and are placed with centers 2 ft. 6 ins. apart, and are treated with 12 lbs. of creosote per cubic foot. In streets where granite paving block is used the concrete bed, which is only 8 ins. thick, is covered with a 2-in. layer of sand. Upon this 5-in. granite blocks are laid. Continuous rail joints are used in all track construction. The joints of the Trilby rails are bonded with two compressed terminal bonds of No. 0000 capacity, and cross bonds are located at intervals of 500 ft. The rails of special work in paved streets are 9 in. 119 lbs., and of the grooved girder type.

Memphis is very much cut up by steam roads, and, as a consequence, there are in the neighborhood of 120 separate crossings with steam tracks in the city and suburbs. In reconstruction, those in the city streets have been framed up with 12 in. x 16 in. pine or cypress timbers under both steam road and electric rails. This framing rests on a 1-ft. bed of concrete, and is rock-filled. These crossings are bonded with three No. 0000 copper wires embedded in concrete under the rock foundation.

In suburban track construction the ballast consists of

MARKET STREET, LOOKING EAST FROM MAIN STREET, MEMPHIS

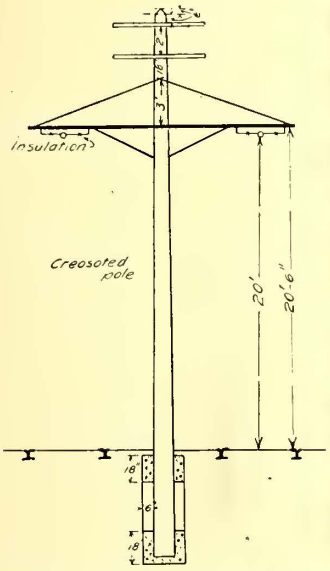
PEABODY AVENUE, LOOKING EAST OF RALEIGH AVENUE, MEMPHIS

10 ins. broken stone with screenings on top. The ties are creosoted, and are placed with centers 2 ft. apart. Standard 70-lb. T-rails, bonded with two No. 0000 bonds, are used.

OVERHEAD CONSTRUCTION

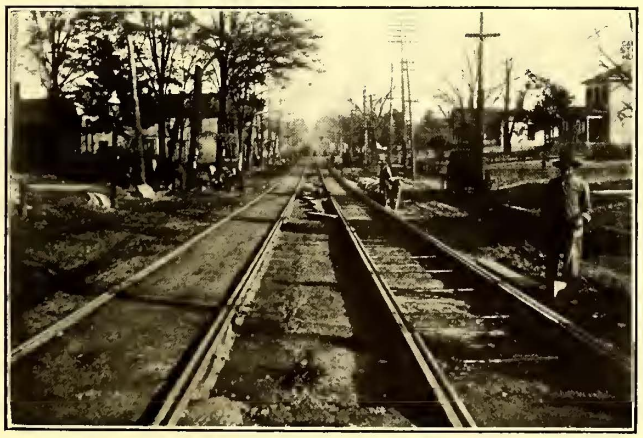
An attempt is being made in Memphis to reduce the total number of poles in the street, by having the different companies unite in their use of poles. A combination of this kind has been effected by the street railway company with the electric light and telephone companies. In these cases the cost of the material and labor of the pole line without attachments is borne in proper proportion by the companies interested, but each company attaches its own crossarms and brackets. In this kind of construction, wood poles only are used. Those used jointly by the lighting company are of chestnut, and have 10 ft. of their butts treated with three coats of a carbolineum compound. Poles used jointly with telephone companies and those used by the railway company only, are of long leaf yellow pine-heart timber, and are creosoted with 12 lbs. of dead oil coal tar per cubic ft. Previous to the treatment, they are seasoned, being submitted first to the direct application of live steam to a temperature not exceeding 250 deg. F., and then to a vacuum of 22 ins. An inspector is located at the works of the creosoting plant to assure of the process being carried out according to specifications.

Wood poles vary in height from 35 ft. to 60 ft., the longest ones being those used jointly by the electric light, telephone and railway companies. In such instances the lighting companies use the top of the pole, the telephone companies that portion immediately underneath, and the railway company the lower portion. In the city limits all poles used in joint construction are set with a rake of 12 ins. from the top of the pole to the rail, the rake being limited because of the telephone wires. Outside the city limits a 23-ft. pole is given a rake of 36 ins.



MEMPHIS STREET RAILWAY COMPANY'S STANDARD CENTER POLE CONSTRUCTION

SPECIAL WORK INSTALLATION AT MAIN AND MADISON STREETS, MEMPHIS



VIEW ON POPLAR STREET, MEMPHIS, DURING TRACK CONSTRUCTION

RALEIGH SPRINGS LINE, LOOKING EAST FROM TREGEVANT AVENUE TOWARD BINGHAMPTON, TENN.

STEEL POLES

In the underground district, which embraces one-half square mile, a 30-ft. steel pole is used. This pole is made up in three sections, one 16 ft. long, one 9 ft. 6 ins. long,

and a top section 7 ft. 6 ins. long. On straight portions of track a pole weighing 893 lbs. is used, but the extra heavy poles used on curve construction have a weight of 1552 lbs.

POLE SETTING

All poles are set in concrete, at a depth varying from 7 to 8 ft.

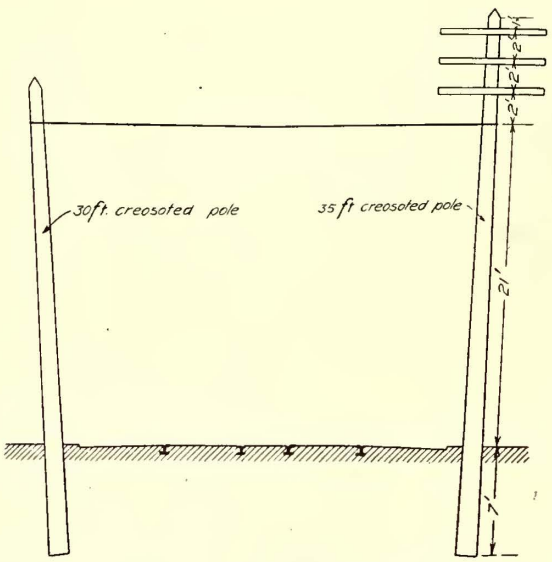
The standard setting for a wood pole provides for the 18-in. bed of concrete at the base of the pole. The concrete is 6 ins. thick on all sides, and extends 4 ins. below the butt. Dirt, tamped in on top of the concrete, fills the hole to within 18 ins. of the top. The remainder is filled with concrete. This upper bed of concrete is used in order both to assist in keeping water from leaking through from the gutter, and to prevent stresses on the poles breaking the curb. In the setting for steel poles the hole is filled up solid with concrete.

TROLLEYS

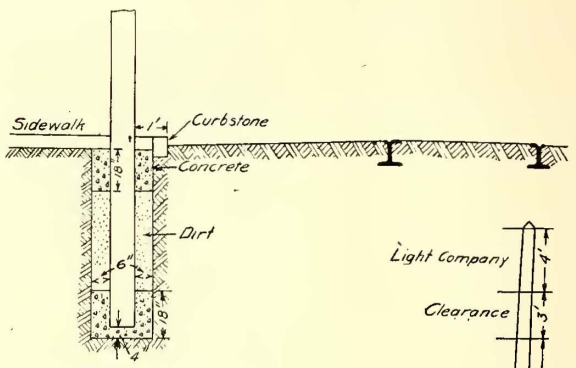
In all new construction, grooved No. 0000 trolley wires have replaced No. 1 and No. 00 round wire. In double track construction on wide streets in the resident districts a center pole is used, and the hangers are supported on brackets. On curves, however, center poles are abandoned, and at curves the trolley is not offset, but is kept over the center of the track.

FEEDERS

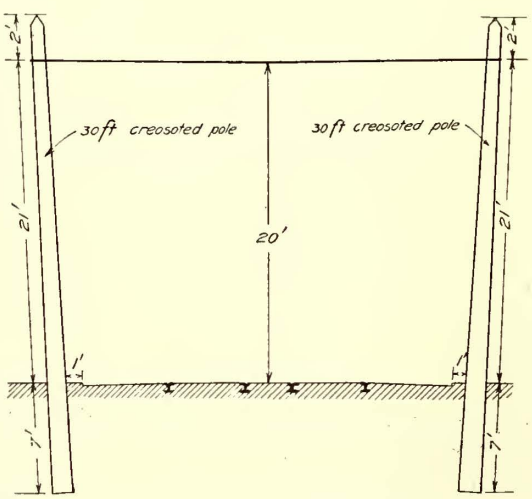
At the present time three feeder trunk lines leave the station in a northwest, northeast and southwest direction respectively. Within a radius of 1500 ft. of the station these feeders consist of 500,000 circ. mil cables. The construction department, which has already put up 55,000 ft. of 500,000 circ. mil cable, will standardize on this size and on No. 0000 wire. Present feeders include Nos. 1, 2, 3, 4 wire, and 350,000 circ. mil cable. In new construction, feeders are tapped to the trolley at 1000 ft. and 1500 ft. intervals, through No. 0000 feed spans. At each feed span is placed a General Electric type M. D. lightning arrester, which is grounded through a No. 0 bare copper wire. Near the ground this wire is protected by a ½-in. galvanized iron pipe 10 ft. long, and which has 2 ft. of the lower end buried in the ground. To prevent the pipe exercising a choking effect, it is made a part of the conductor by being soldered effectively to the wire at each end. The end of the pipe is, in fact, entirely closed by solder, so as to make the interior air-tight. As the soil in Memphis is always



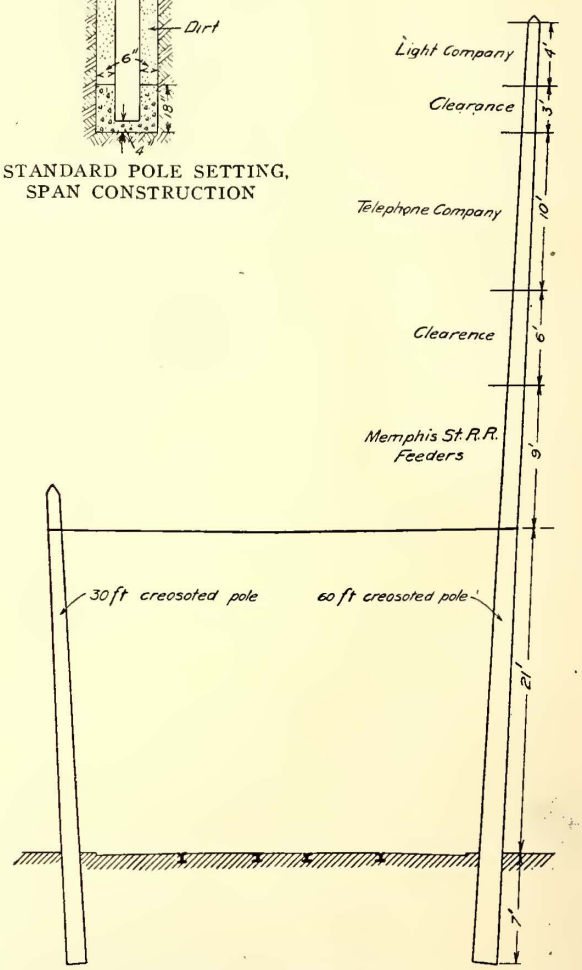
RAILWAY COMPANY'S SPAN CONSTRUCTION WITH FEEDERS BUT NO JOINT USE



STANDARD POLE SETTING, SPAN CONSTRUCTION



RAILWAY COMPANY'S SPAN CONSTRUCTION WITHOUT FEEDERS OR JOINT USE



SPAN CONSTRUCTION FOR COMBINED RAILWAY, LIGHT AND TELEPHONE SERVICE

moist, the pipe alone serves as an effective ground, and no ground plates are used.

GROUND RETURNS

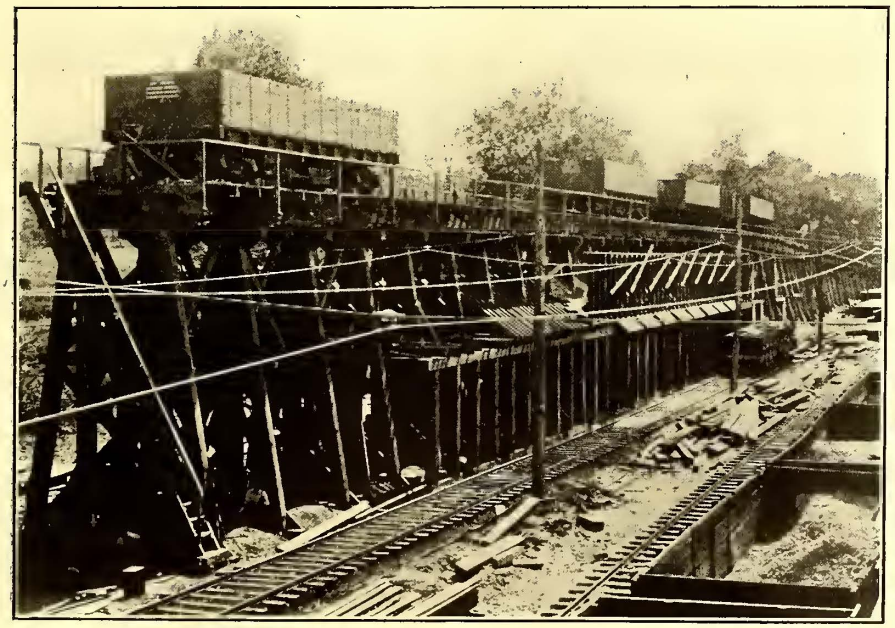
Overhead ground returns are being supplemented with old rails laid underground in concrete. One such return already installed consists of eight 103-lb. 9-in. girder rails laid parallel in concrete. They are bonded with three No. 0000 circ. mil bonds at each joint.

It is proposed to install another similar return, which will be carried to the power house from the northern portion of the city. This will probably consist of 94-lb. 9-in. girder rails embedded in concrete. The joints will be bonded with three No. 0000 bonds, and the rails will be cross bonded every 500 ft. The number of rails laid parallel will vary from three to ten, according to the distance from the power house.

POWER HOUSE IMPROVEMENTS

The power house plans contemplate the erection ultimately of an entirely new station containing five 2000-kw units. The installation of the first unit has been completed. This has been installed in a building measuring 160 ft. x 50 ft., erected contiguous to the old power house. This building has a temporary east wall, and will eventually be simply one of the five bays of the new power house. The new engine room contains an Allis-Chalmers vertical cross-compound condensing engine, direct-connected to a 2000-kw General Electric generator. The condenser is of the barometric type, with the pumps located in the basement around the engine foundations.

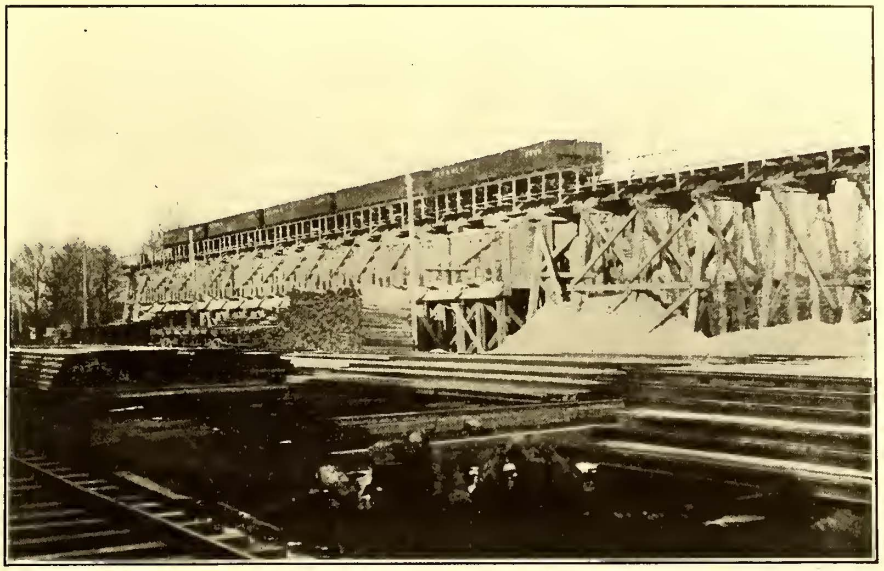
The boiler installation in the new extension consists of four 600-hp Stirling boilers with Cahall superheaters, all of which are served by one temporary stack 150 ft. high. In the steel work and in the height of the boiler room provision has been made for a coal bin to be installed later.



BINGHAMPTON STORAGE TRESTLE UNDER CONSTRUCTION

CAR HOUSE IMPROVEMENTS

South of the repair shops there has just been erected a brick and steel car storage barn measuring 205 ft. x 372 ft. The barn has a capacity for 200 cars. It consists of three bays, each containing six tracks. Entrance is from the west end, but girders have been built in the east so as to permit door openings to be made in this wall should it ever be desired.



BINGHAMPTON STORAGE TRESTLE

The building fronts on a street with considerable grade. To overcome this the building has been set back about 60 ft. and a concrete retaining wall built, thus giving sufficient space to lay the barn curves on practically level grade and all on private property of the company.

STORAGE YARDS

At Binghampton, a suburb of Memphis, about six miles north of the city, the construction department has established a storage yard, where all track and building material is received and stored until used. From this yard all the materials are distributed to points at which they are used in the railway company's cars. The yard has track connections with the Louisville & Nashville and the Union Railways. To facilitate the handling of rock ballast, a storage trestle with a long bin below it has been erected in the yards. The trestle is about 25 ft. high, and holds five standard drop bottom gondola cars. The ballast in the bins is let down in the electric freight cars by simply lowering chutes and opening gates.

The construction work is carried out by Ford, Bacon & Davis, engineers for the railway company, under the supervision of the latter's president, T. H. Tutwiler.

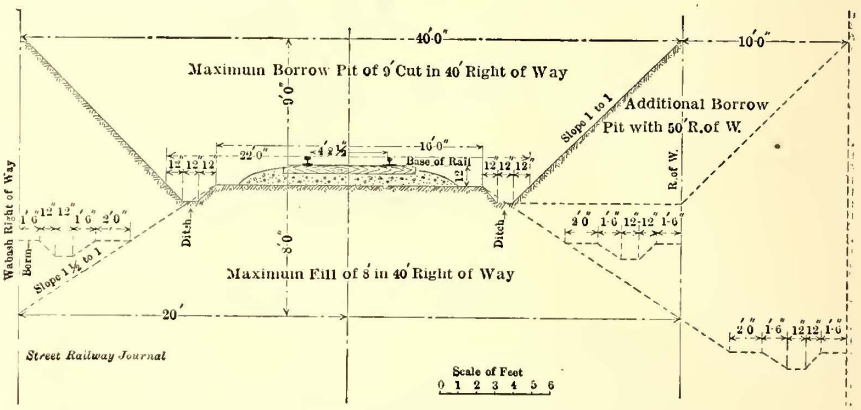
A taximeter cab service will be established at the Manhattan terminal of the Hudson tunnel.

THE PROPER CONSTRUCTION AND MAINTENANCE OF TRACKS IN ELECTRIC RAILWAY SERVICE

BY H. L. WEBER,
Chief Engineer, Fort Wayne & Wabash Valley Traction Company

There are so many different requirements existing in each case that it is almost impossible to compile a set of specifications for track construction and maintenance practicable for all conditions, or even for the entire length of one system, unless made very elastic. This is largely due to the important geological changes which may occur in very short distances, since each formation requires individual treatment. However, every properly regulated railway should have standard plans and specifications by which to do its work. The track in a city or through towns should be made of a permanent character as the street improvements advance. It is often a question that must be thoroughly studied, whether or not a track when first laid should be of permanent way at once or of temporary nature, with the idea in mind of changing it to a permanent way at some future time. The points that directly govern this matter are as follows: Has or can the street grade be established so the tracks can be placed to a permanent grade? Have the sewers, water, gas and other fixtures been laid? Can the track be made a permanent way without paving the balance of the street? Would it be a paying investment to make it a permanent way—that is, would the traffic justify the outlay?

The first requisite for any and all tracks is thorough drainage, particularly around switches and other special work. This can generally be done by surface drains with the proper track appurtenances and by connections made to sewers or other outlet drains. By working in conjunction with the city engineer and other city officials, it is generally possible to secure grades which will carry off the surface water so it will not accumulate at special work or street corners, where passengers board or leave the cars.



STANDARD ROADBED CROSS-SECTION FORT WAYNE & WABASH VALLEY TRACTION COMPANY

As the foundation starts at the subgrade, the subgrade must be made unyielding to the stresses transmitted to it, through the rails to the ties, then to the ballast and finally to the subgrade, which in reality is the ultimate foundation. This foundation, generally called the subgrade, can in most cases be made more solid by rolling and kept from getting soft by thorough drainage. This can be accomplished with the ordinary drain tile in most cases, although in some cases resort must be made to blind drains of gravel or crushed stone. All subgrades requiring it should be drained, and most subgrades, except those of sand and gravel, require subdrainage.

The kind of ballast or foundation under the ties depends largely upon the ties used. If steel ties are employed I would use concrete, although a good wood tie completely enveloped in concrete should last for 25 years or more. I have taken up wood ties in Richmond, Ind., that had been in the track for 11 years and found them as good as when laid. Sheet concrete of 1-3-6 mixture deposited wet under the ties need not exceed 6 in. under the tie in most instances. This depth of concrete with the ordinary tie will give you a foundation 12 in. deep, provided the foundation stops at the base of rail. The wood tie, the Carnegie and other steel tie or even the old rail tie, where the proper rail fastenings have been provided, will give good service. There is no reason why a rail fastening anchored directly into the concrete should not be satisfactory. One thing is necessary, however, with this kind of construction; that is, more time is needed for the concrete to set after it is in place before it can be used than in the cross-tie construction; but when the time can be given it to season, I would recommend the Plan "A" construction, shown on page 85 of the issue of this paper for Jan. 18. I cannot figure that it will cost much less or be any better than the steel ties at present prices, although it will tend to keep the steel tie near a reasonable price, if the price is not already so. "Competition is the life of trade" and the engineer who can devise a practical way to keep this competition up, and the price of ties down, is earning his salary.

The weak places in a track are the joints. Any joint is liable to get loose no matter what kind of splices are used, or how much care the foreman exercises. Somebody will fail to do some little thing at the proper time and unless the inspection is perfect a failure will result sooner or later. To minimize failures at joints, I would recommend some kind of reinforcement under all joints in the concrete foundation in addition to using the best possible rail joint. This will not only provide against possible failure at the joints, but will protect the bonds. If a joint fails in a paved street it costs many times more to fix the street paving than it does the joint. He is a wise manager who adopts a well-devised plan for a permanent way, for by so doing he will save money and annoyance on maintenance of track, car equipment and overhead construction.

The rail for city tracks need not exceed the 6-in. 73-lb. per yard section of the Pennsylvania Steel Company, in so far as strength is concerned. It may be necessary on account of using deep granite block or stone paving material, to adopt a deeper rail section; but for brick or asphalt paving the 6-in. or 5¾-in. rail sections are sufficiently deep. The ties should be at least 7 ft. long, although a steel tie 6 ft. 6 in. long imbedded in concrete will answer. Should old rails be employed five 7-ft. 6-in. ties to every 33-ft. rail will answer the purpose very nicely, or four ties to a 30-ft. rail. The kind of pavement generally is fixed by the city authorities. However, no pavement has given better satisfaction for the money invested than brick, except perhaps well constructed macadam. It is remarkable how long a good macadam street will last, how cheaply it can be constructed and maintained in most localities and how generally satisfactory it has proved from every point of view.

The success of a track and the paving depend upon firmly holding the rails in position, for if there is the least bit of give in the rails, the pavement will soon work loose and prove a failure. The rail should be of such strength that there will be no bending; the fastenings should be sufficiently close and strong to hold the rail rigidly in position, and the foundations sufficiently wide, deep and strong to distribute the load so as not to overtax the bearing qualities of the subgrade. If the bearing qualities are overtaxed they will be a failure. Hence an 8-ft. tie is a necessity for heavy traffic in most cases.

The maintenance of city tracks should at all times be kept up to the highest standard. To do this on switches and other special work, car wheel maintenance must not be neglected and cars operated over special work with proper care. Bad operation causes broken flanges, broken switch points and derailments. These things mean delays, and delays always mean that people will walk away with your nickels, or the nickels they would gladly have given for transportation to their journey's end.

Instructions for Field.

Find Tangent Distances by No. ② then Measure out. This Distance each way from the P. I. and set P. S. and P. T. S. Than with Instrument at P. S. on Tangent, use the Deflections from Column 4 and Lengths from Column 1 set in Stakes. Then move up to the Point Curve P. C. and with Back Sight on P. S. Turn off "△"-Deflection Angle found in Column ⑥ for Tangent to Spiral at P. C. Then Run in the Central Simple Curve for ("2△") Then set on P. T. S -and Back in Spiral as in Preceding Case.

P. I. = Point of Intersection. P S. = Point Spiral,
P. S. = Point Curve. P. T. = Point Tangent. Curve and Spiral.
P. T. S. = Point Tangent Spiral.

Table No. 1

1° in 60' Spiral — For High Speed Curves from 0 to 3°

Length of Spiral	Degree of Cent Curve	Central Angles	Deflection for Chords	Off-Set "O" from Tangent	△ = Defel
10	0 10′	0 00′	0 00′	0.00′	0 00′
20	0 20′	0 02′	0 01′	0.00′	0 01′
30	0 30′	0 05′	0 02′	0.00′	0 03′
40	0 40′	0 08′	0 03′	0.01′	0 05′
50	0 50′	0 13′	0 04′	0.02′	0 09′
60	1 00′	0 18′	0 06′	0.03′	0 12′
70	1 10′	0 25′	0 08′	0.04′	0 16′
80	1 20′	0 32′	0 11′	0.05′	0 21′
90	1 30′	0 41′	0 14′	0.09′	0 27′
100	1 40′	0 50′	0 17′	0.12′	0 33′
110	1 50′	1 00′	0 21′	0.17′	0 40′
120	2 00′	1 12′	0 24′	0.21′	0 48′
130	2 10′	1 25′	0 28′	0.27′	0 56′
140	2 20′	1 28′	0 33′	0.33′	1 05′
150	2 30′	1 53′	0 38′	0.41′	1 15′
160	2 40′	2 08′	0 43′	0.50′	1 25′
170	2 50′	2 25′	0 48′	0.60′	1 37′
180	3 00′	2 42′	0 54′	0.71′	1 48′
190	3 10′	3 01′	1 00′	0.83′	2 00′
200	3 20′	3 20′	1 07′	0.97′	2 13′
210	3 30′	3 41′	1 14′	1.12′	2 27′
220	3 40′	4 02′	1 21′	1.29′	2 41′
230	3 50′	4 25′	1 28′	1.48′	2 56′
240	4 00′	4 48′	1 36′	1.68′	3 12′
250	4 10′	5 13′	1 44′	1.89′	3 28′
260	4 20′	5 38′	1 53′	2.13′	3 45′
270	4 30′	6 05′	2 01′	2.38′	4 03′
280	4 40′	6 32′	2 11′	2.66′	4 21′
290	4 50′	7 01′	2 20′	2.95′	4 40′
300	5 00′	7 30′	2 30′	3.27′	5 00′

Table No. 2

1° in 10' Spiral — For High Speed Curves from 9 to 18°

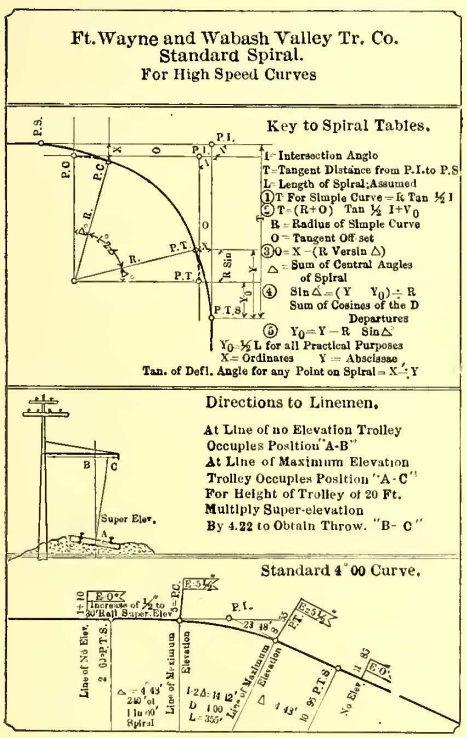
Length of Spiral	Degree of Cent Curve	Central Angle	Deflection for Chords	Off-Set "O" from Tangent	△ = Defel
10	1 00′	0 06′	0 03′	0.00′	0 03′
20	2 00′	0 18′	0 07′	0.01′	0 11′
30	3 00′	0 36′	0 14′	0.05′	0 23′
40	4 00′	1 00′	0 22′	0.09′	0 38′
50	5 00′	1 30′	0 33′	0.15′	0 57′
60	6 00′	2 06′	0 46′	0.24′	1 21′
70	7 00′	2 48′	1 00′	0.37′	1 48′
80	8 00′	3 36′	1 16′	0.52′	2 20′
90	9 00′	4 30′	1 35′	0.72′	2 55′
100	10 00′	5 30′	1 55′	0.95′	3 35′
110	11 00′	6 36′	2 18′	1.24′	4 18′
120	12 00′	7 48′	2 42′	1.58′	5 06′
130	13 00′	9 06′	3 09′	1.96′	5 57′
140	14 00′	10 30′	3 38′	2.42′	6 52′
150	15 00′	12 00′	4 08′	2.93′	7 52′
160	16 00′	13 36′	4 41′	3.51′	8 56′
170	17 00′	15 18′	5 15′	4.17′	10 03′
190	18 00′	17 00′	5 51′	4.89′	11 15′

Table No. 3

1° in 30' Spiral — For High Speed Curves from 3 to 9°

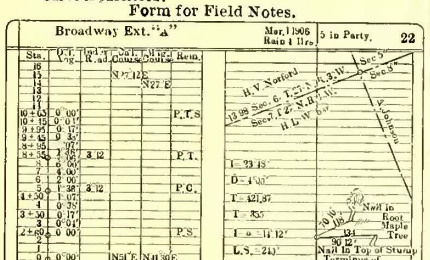
Length of Spiral	Degree of Cent Curve	Central Angles	Deflection for Chords	Off-Set "O" from Tangent	△ = Defel
10	0 20′	0 02′	0 01′	0.00′	0 01′
20	0 40′	0 06′	0 03′	0.00′	0 03′
30	1 00′	0 12′	0 05′	0.01	0 07′
40	1 20′	0 20′	0 07′	0.02′	0 13′
50	1 40′	0 30′	0 11′	0.03′	0 19′
60	2 00′	0 42′	0 15′	0.05′	0 27′
70	2 20′	0 56′	0 20′	0.09′	0 36′
80	2 40′	1 12′	0 25′	0.13′	0 47′
90	3 00′	1 30′	0 32′	0.17′	0 58′
100	3 20′	1 50′	0 38′	0.25′	1 12′
110	3 40′	2 12′	0 46′	0.33′	1 26′
120	4 00′	2 36′	0 54′	0.41′	1 42′
130	4 20′	3 02′	1 03′	0.54′	1 59′
140	4 40′	3 30′	1 12′	0.68′	2 18′
150	5 00′	4 00′	1 23′	0.81′	2 37′
160	5 20′	4 32′	1 33′	1.01′	2 59′
170	5 40′	5 06′	1 45′	1.21′	3 21′
180	6 00′	5 42′	1 57′	1.41′	3 45′
190	6 20′	6 20′	2 10′	1.09′	4 10′
200	6 40′	7 00′	2 23′	1.90′	4 37′
210	7 00′	7 42′	2 38′	2 24′	5 04′
220	7 20′	8 26′	2 52′	2.61′	5 34′
230	7 40′	9 12′	3 08′	2.97′	6 04′
240	8 00′	10 00′	3 24′	3.32′	6 36′
250	8 20′	10 50′	3 41′	3.81′	7 09′
260	8 40′	11 42′	3 58′	4.27′	7 44′
270	9 00′	12 36′	4 17′	4.74′	8 19′

Ft. Wayne and Wabash Valley Tr. Co.
Standard Spiral.
For High Speed Curves



Note: In Tables 2. & 3. for "L," "△" and Deflection Angle, "O" & (△ − Def. Angle) use the Line just above the Line on which the Central Simple Curve is Inscribed.

Form for Field Notes.



Super-Elevation Table

Degree of Curve	Super-Elevation Table Elev. in Inches in Column under Speed per Mile						
	20	25	30	35	40	45	50
1°	1/16″	3/16″	5/16″	13/16″	1 1/16″	1 3/8″	1 11/16″
2°	3/16″	7/16″	1 1/16″	1 11/16″	2 3/16″	2 3/4″	3 7/16″
3°	13/16″	1 5/16″	1 7/8″	2 1/2″	3 5/16″	4 1/8″	5 1/16″
4°	1 1/16″	1 11/16″	2 1/2″	3 3/8″	4 3/8″	5 9/16″	6 13/16″
5°	1 3/8″	2 1/8″	3 1/16″	4 3/16″	5 7/16″	6 7/8″	8 1/2″
6°	1 5/8″	2 1/2″	3 5/16″	4 1/2″	6 5/16″	8 1/4″	
7°	1 7/8″	2 7/8″	4 1/2″	5 7/8″	7 3/4″		
8°	2 1/8″	3 5/16″	4 3/4″	6 1/2″	8 3/8″		
9°	2 3/8″	3 3/4″	5 3/8″	7 1/4″			
10°	2 7/8″	4 1/8″	5 7/16″	8 1/16″			
12°	3 1/16″	5″	7 1/8″				
14°	3 11/16″	5 3/4″	8 3/16″				
15°	4 1/16″	6 5/16″					

Super-Elevation should always be Maximum at P.C. and P.T. and should Diminish One Half Inch to Thirty Feet; each way from Central Simple Curve Regardless of the Position of P.S. and P.T.S. Inside Rail should never be Depressed to get Full Elevation.

Interurban maintenance should be a continuous process if any pretensions are made to speed or to meet the competition of steam railroads. The cars of any interurban railway on a schedule requiring them to make 114 miles in 3 hours and 55 minutes, running slowly through cities and making a limited number of stops, are "going" some." This is the usual schedule of the Fort Wayne & Wabash Valley Traction Company and the Indiana Union Traction Company's "Limited." It means that the actual running time between most stations and meeting points is 45 miles per hour, with frequent spurts of speed of 65 miles per hour. With cars weighing 50 tons going at the rate of 45 to 65 miles per hour, how long can a general manager safely neglect his track? If this is the question that confronts the managers of interurban railways it has an easy answer, and that is, Not one day. Under these conditions of operation section men must be kept constantly upon the track. Of course, the better the original construction the easier the maintenance; but however small the maintenance required, the track must or should be kept up to its highest efficiency, first, for public safety, and, second, for keeping down the maintenance expenses on the cars and overhead work. There is no question that the road properly completed in the first place and properly, not lavishly, maintained, will in the end show the best returns.

A new railway should have a 16-ft. roadbed, with 1 ft. to 1½ ft. side slope on fills and 22-ft. roadbed in cuts, from which one can have a ditch 1 ft. deep with 1 ft. base and side slope one to one on either side. This will give room to set the pole line on the edge of the roadbed without obstructing the ditches. The ties should be at least 6 in. x 8 in. x 8 ft. and the rails 16 ft. to 33 ft. long of 70-lb. section laid with broken and suspended joints. By this method of laying, the curves are kept more easily

in line, and the suspended joints afford more bearing to support the joint. The track should be ballasted with at least 8 in. of gravel or 6 in. of crushed stone under the ties, and properly dressed up in either case. The lower the percentage of grade the better, but the degree of curvature for high-speed track should not exceed 4 deg. with a 240-ft. spiral at each end. There should be no reverse curves. Curves reversing should have at least 300 ft. of tangent between curves; 500 ft. would be better. Curves spiraled by the table on page 535, compiled by H. V. Norford, division engineer of the Fort Wayne & Wabash Valley Traction Company, have been in satisfactory use on that system for the past three years. The spiral by these tables is made very simple, comprehensive and convenient. The field work also is simple and the engineers grasp the idea of location very quickly. The super elevations as shown by the table are also used for a speed of 15 m.p.h., although no elevation on the system exceeds 8 in. At curves where the normal speed would require an elevation of more than this amount the motorman is cautioned to run his car slowly. The precautionary word "slow" is painted in black letters on a white background on the fifth pole from the point of curve at each end.

As already stated, the track, curves and the overhead system are so closely related that any defect in the first will tell quickly on the two latter. On the other hand, defects in either the rolling stock or the overhead system have no injurious effect on the track except where they are related to the car wheels. In other words, the track is the foundation of the system. If the cars run smoothly it is because the track is well aligned, the grades are low and the curves have been given the proper elevation. If, on the other hand, the track is in poor condition the effects are transmitted through the wheels to the motors and car and even to the overhead structure.

I do not believe in lavishly maintaining some portions of the track and neglecting others. The entire line must be kept up to the same standard to make the operation easy. This can best be done by dividing it up into sections each several miles in length. The "Wabash Valley Route" is divided into 8-mile sections, each in charge of a foreman, who reports to the roadmaster of the company. The roadmaster reports to the chief engineer, who is assisted by an engineer of maintenance and way. We have an organization called the Maintenance of Way Association which meets every week at either Fort Wayne, Logansport or La Fayette. All section foremen are expected to attend these meetings with as many of the section men as possible. Each section foreman's wants and the manner he is handling his work are made known, and ways and means are considered for supplying the first and improving the second. The comparative values of different track tools and material are also thoroughly discussed. This organization is a little over two and one-half years old, and in that time we have completely reorganized our system of maintenance, constructed 65 miles of new line and eliminated most of the sharp curves on 76 miles of line.

We are great believers in organization and of making each section foreman responsible for his division or section. He is at liberty to hire whom he pleases and we look to him for results; we hardly ever have to look the second time to find them. The meeting at each place is presided over by its chairman and secretary. The minutes are typewritten and copies sent to the chief engineer and to the general manager. In this manner the general manager can see at a glance what is needed and what is being done by the "men behind the gun." This he greatly appreciates, for his success depends largely upon the faithful service of his men. Fra Albertus, of Roycroft fame, is responsible for the motto: "Get out or get in line." Ours is like it, but modified to read: "Get your track to line, grade and gage and keep it there, or get out."

Some sections are maintained with less work than others on account of more and better materials used in the construction. It often occurs that we at times must bunch our forces to help one another out on some particular piece of work. This we can conveniently do on account of our frequent service, a thing that would not be possible or practicable on steam railroads to the extent that we do it. We try to work upon the principle that "a thing worth doing is worth doing well"; if we can't do it as well as it should be done we do it as well as we can under the circumstances, ever bearing in mind that "a stitch in time saves nine." It is our aim to have all things looked after and maintained by each section foreman upon his section. This includes culverts, bridges to a certain degree, fences, roadbed, switches, switch lamps. For lamps we use the long-time burning oil burners, which are filled and looked after twice each week.

In the maintenance of way one of two policies can be followed. The first is to spend a considerable amount each year in keeping the track in proper condition; the second is to spend a small amount for a series of years and then a larger amount at the end of, say, a five-year period. Strictly speaking, to obtain a proper comparison of the expense of each of these methods, in fact, to determine the amount correctly to be charged to track maintenance, a portion of the cost of the repairs to cars, equipment and the overhead system should also be included. Low track maintenance is accompanied by high car and overhead maintenance costs, but when the track is kept in good condition the repair charges on this part of the equipment should be low. If considered purely from the standpoint of the track the second policy might show lower disbursements than the first, but if all of the facts mentioned are considered the first plan should be by far the more economical. Under interurban railway conditions as they exist in Indiana, a very close relation can also be found between the original cost of track construction and that of track maintenance. With a track consisting of 70-lb. to 80-lb. rails, well tied together and ballasted, the annual maintenance cost is small. Where the rails used are from 56 lb. to 60 lb. per yard and the ballast is light the cost of maintenance is many times greater than with the heavier sections; moreover, the curves demand constant watching and work of keeping them in line. On the Ft. Wayne & Wabash Valley Railway it has also been found that the one-car trains are harder on curves than the two-car trains, as the second car seems to steady the train.

I cannot see that interurban railroads should differ materially from steam roads in their mode of maintenance. Those that have the heavy fast traffic must keep the roadbed well maintained, and those doing a purely local interurban business where the speed of 15 to 18 miles per hour is seldom attained and rarely exceeded, can permit practices that cannot be tolerated in the former. I would say that on a fast through interurban line the policy of spending a considerable amount each year must be adhered to, and that in the other case the policy of making a heavy expenditure every five years might be admissible and prove the cheaper plan of the two. I doubt the assumption, however, and further doubt whether any one is in a

position to give a definite verdict. It is a foregone conclusion. We must all admit that upon any track where the speed of 25 to 45 miles per hour is attained, and the schedule requires it kept at that speed, the track must be maintained to a good line and grade, and this can be done only by constant attention. We go over the entire length, line and surface, of each section once a year, and dress it up after the new ties are in place. As the joints go down they are brought up to grade and relined. We aim to get our track in the best possible condition in the summer with our regular section gangs, which are reduced to a minimum in the winter. Then, if additional help is required for ballasting, snowstorms or other cause, temporary labor is engaged or the gangs are concentrated.

THE VALUE OF A UNIT.

BY D. F. CARVER.

Wherein lies the value of the unit?

That abstract form which is the product of the imagination;

That intangible unity which is not capable of further subdivision, which we call the atom of chemical elements and the molecule of other substances;

Or the ton or passenger mile for traffic considerations; or the car or train mile for transportation and maintenance considerations; or the car or train hour for financial consideration; or the numberless units which are the products of the trained mental faculties which are working for betterments in any line of endeavor.

We work with comparisons. We act from the best point apparent of cause and effect. We scheme and plan and cut and try. Judgments are formed from the preponderance of evidence. Extremely appropriate and truthful simplicity is required for this work and it is herein that its value in the unit lies.

An element of these units of comparison for railway work is always some form of progression. A car or train, an engine or motor moves one mile at some not determined rate; perhaps it moves swiftly, perhaps slowly. In many cases there may be assumed a progression which exists but infrequently. Rarely in cases of comparison on the basis of train or car miles is the feature of the varying rates of progression, or speeds, given close consideration. Often neglected completely, it is sometimes the answer to a leading question.

The other form of progression is not so frequently used as a factor in the unit of railway comparisons. Nevertheless it is of much importance, perhaps the greater, for it is always coming and always going, without haste and without rest. Its rate of progression does not admit of any variation. I refer to time and its combination into the unit expressed by the car-hour or car-day of a stated number of hours.

Earnings and expenses per car-hour are expressions which are definite and are not easy to conjure with. It is the difference between the first and the second of these expressions, the right sort of a difference, which it is necessary to get.

The progression of time brings these that follow, regularly and inexorably:

Taxes by the year.

Interest by the year or half year.

Insurance by the year.

Rentals at regularly recurring periods.

Pay rolls by the week and the month and dividends at some interval of time.

These make up the great volume of disbursements. The money and credits to meet them as they come due must be accumulated by the day and the hour. The car and the corps are the means at hand to do it. Their direction and guidance should be from the basis of a unit which is a component part of the results striven for, ample and sufficient returns within the limits of time. This is the car-hour unit.

In connection with the standard of money value, or some other standard, or something tangible, these units are made into columns of figures and often rows of columns of figures and are statistical information. Used in the broader sense they speak the language of progression. But only a progression from some time in the past to some time in the more recent past. If "up to date," then the expression is from some time in the past to the present. But nevertheless they always are, in the language of the street, "has beens." Can they be used to guide the progression from the present into the future? Yes, and with a wonderful degree of precision.

When we send a survey party into the field to locate a line for railroad construction the majority of the men are employed in taking backsights and foresights and the calculated and magnetic courses. The backsight is just what its name implies—a glance through the transit back through the imaginary but exact vertical plane which has just been traversed; for guidance in throwing the foresight into more or less obscurity. The backsight is always clearer than the foresight.

By proper charting is there much made visible which would otherwise remain undisclosed. The statistics, the records of some progression from the past to the present, are the backsights of the mental survey which seeks to guide the future progression so that it will not go high into the air (commonly called the bottom falling out of the thing) nor deep into a slough. But the chart holds the key to the situation, for by it can the eye see what the mind must comprehend. Borrowing from the great Thanatopsis:

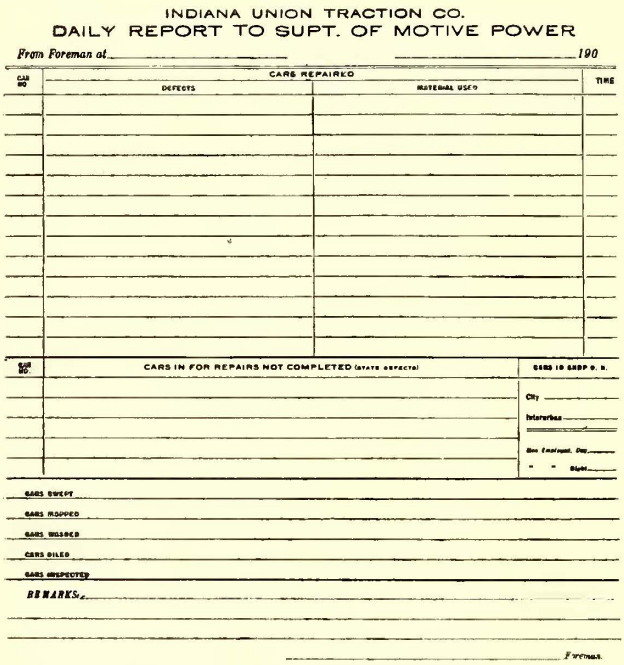
> "To him who, in the love of Nature,
> Holds communion with her visible forms,
> She speaks a various language."

Great logical truths which have been built in religion, in the sciences, in the arts, in mathematics, are often founded upon basic principles which are so simple that the only answer to the question, Why? is: Because it is, or vice versa. Yet would any thinking mind attempt to demolish these structures of thought because he could not comprehend the extreme simplicity upon which they rest? Great bridges and buildings are built and follow the simple proposition that a straight line is the shortest line connecting two points. Great railroads are built with four or more main tracks in recognition of the simple principle that two bodies cannot occupy the same space at the same time. Great clearing houses exchange thousands of millions of credits and cash annually assuming the truth of the very simple basic fact that two things which are equal to the same thing are equal to each other: all vast accomplishments subject to simple axiomatic truths.

So around the simple unit of car mileage or car hours there can be built a system; with its axioms and its extended opportunities, its broadened views, its comprehensive use of averages, its restriction of the unfavorable elements of choice and chance, which by the certainties of yesterday there can be reduced the uncertainties of to-morrow.

MAINTENANCE OF ROLLING STOCK BY THE INDIANA UNION TRACTION COMPANY

The Indiana Union Traction Company has recently completed and now has in full operation new car repair shops at North Anderson, Ind., which are the most modern and complete in design and in equipment to be found on any interurban road in the country. These shops for making heavy repairs and general overhauling in connection with the four inspection depots at Marion, Muncie, Tipton and Elwood, with their facilities for making light repairs, enable


INDIANA UNION TRACTION CO.
DAILY REPORT TO SUPT. OF MOTIVE POWER

From Foreman at _____ 190

CAR NO.	CARS REPAIRED		TIME
	DEFECTS	MATERIAL USED	

CAR NO.	CARS IN FOR REPAIRS NOT COMPLETED (State defects)	CARS IN SHOP 9 A. M.
		City
		Interurban

Cars Swept
Cars Mopped
Cars Washed
Cars Oiled
Cars Inspected
REMARKS:

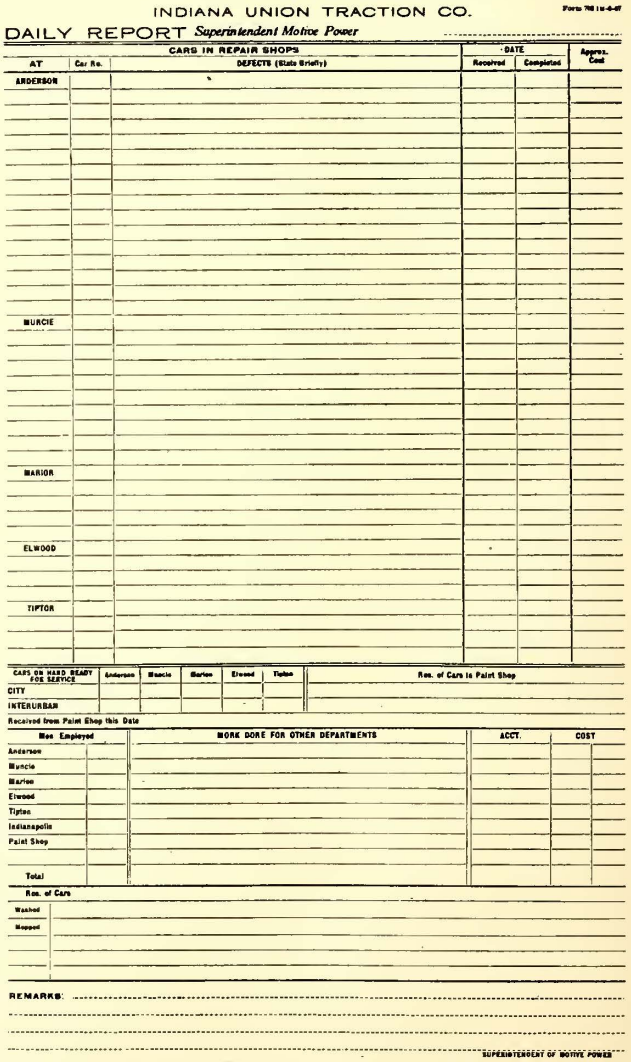
Foreman.

FIG. 1.—DAILY REPORT BLANK TO SUPERINTENDENT OF MOTIVE POWER BY DEPOT FOREMAN

the company to maintain its city and interurban rolling stock with a high degree of efficiency. The Anderson shops are about in the geographical center of the system, while the inspection depots are conveniently located for serving the various interurban and city divisions. The company has in service 71 interurban passenger motor cars and 14 trailers, 17 interurban motor freight and express cars and 6 trailers, 92 city cars and 111 miscellaneous and work cars. These are distributed over the system as follows: At Muncie, 30 interurban and 20 city cars; at Tipton, 7 interurban cars; at Marion, 5 interurban and 25 city cars; at Elwood, 6 city cars; the remainder, including all the interurban freight and work cars, being cared for at Anderson.

The inspection depots are equipped to do only light repairs to trucks and electrical machinery in addition to cleaning and washing down. Three inspectors are employed at each depot, one for bodies, seats, lamps, etc.; one for trucks and brake gear, and one for electric equipment, including trolley, control apparatus and motors. All cars are given a thorough inspection at least once every three days. The through limited cars on some runs which make as much as 500 miles per day are inspected every day. The depots are supplied with spare parts of the control apparatus, spare armatures, journal brasses, mounted wheels, trolley poles and wheels and other parts which can be replaced or repaired without heavy tools. The inspection pits are equipped with body jacks for removing trucks and the truck aisle is served with a hand hoist for lifting motor cases, armatures and truck frames when putting in new wheels. Cars are washed down once every week or 10 days and are swept out and dusted at the end of each day's run. Cars running into Indianapolis are inspected during the layover at the terminal station by a regular inspector and are swept out before leaving the terminal.

When the depot inspectors find defects which cannot be repaired with the facilities at hand, such as grounded fields, broken truck frames or damage to the car body, they report the car into the general shops for repairs. If the troubles do not affect the safe operation of the car it is put on a regular run and routed through to Anderson, where it is relieved by spare equipment and sent to the shop. If the car can be run but not on schedule, or is damaged to such an extent as to make it unfit to carry passengers, it is deadheaded to the shop as an extra train as soon as practicable. In case of complete breakdowns, cars are of course pulled into the shop by an extra motor freight or passenger car. Reports of cars sent to the shop are transmitted by telephone from the inspection depots with a statement of the defects found, to the office of the superintendent of motive power. Provision is then made for putting the car through the shop and back into service as soon as possible after its arrival.


INDIANA UNION TRACTION CO.

DAILY REPORT *Superintendent Motive Power*

AT	Car No.	CARS IN REPAIR SHOPS — DEFECTS (State Briefly)	DATE Received	DATE Completed	Approx. Cost
ANDERSON					
MUNCIE					
MARION					
ELWOOD					
TIPTON					

CARS ON HAND READY FOR SERVICE	Anderson	Muncie	Marion	Elwood	Tipton	Nos. of Cars in Paint Shop
CITY						
INTERURBAN						

Received from Paint Shop this Date

Men Employed	WORK DONE FOR OTHER DEPARTMENTS	ACCT.	COST
Anderson			
Muncie			
Marion			
Elwood			
Tipton			
Indianapolis			
Paint Shop			
Total			

Nos. of Cars
Washed
Mopped

REMARKS:

SUPERINTENDENT OF MOTIVE POWER

FIG. 2.—DAILY REPORT BLANK OF SUPERINTENDENT OF MOTIVE POWER

Each depot foreman makes out and transmits to the superintendent of motive power a daily report of work done and conditions of cars under his charge on the form shown in Fig. 1. This shows the numbers of cars repaired and material used, cars awaiting repairs, cars in condition for service, numbers of cars swept, mopped, washed down,

oiled and inspected. From these reports the superintendent of motive power is informed daily of the condition of every car on the system and can keep track of the cleaning and oiling. They also serve as a basis for making up a daily report of condition of equipment by the superintendent of motive power to the general manager. This is shown in Fig. 2. It gives in condensed form the number of cars held in the main shop and at each of the inspection depots for repairs with a statement of the approximate cost and time of completion of repairs. The bottom half of the sheet shows the shop force, work done for the other departments, number of cars ready for service at each of the depots and the record of car cleaning. The general manager is thus informed at all times of the condition of the company's equipment and the efficiency and capacity of the shop facilities.

Trainmen's reports of delays due to defective equipment are reported through the train dispatcher's office and not by "sign in" sheets at the car barns as is usually done. The dispatcher keeps a separate sheet for each inspection district showing the delays to all cars heading in to each depot. The car and train number, time of delay and cause are entered and these reports are forwarded each day to the superintendent of motive power. Such reports are not intended to give complete or even reliable information as to the reasons for delays or condition of equipment, but they serve as a basis for making investigations of the true cause of the trouble. It is always an easy way of accounting for delays to attribute them to a bad trolley or a lame motor. Each report is looked into and the true cause determined if possible. The work of the division inspection foremen is also checked up from day to day, and if for any reason the cars on one division show up with a large number of road failures the responsibility is traced back and proper measures taken to remedy the trouble. The efficiency of the motormen in making emergency repairs on the road is also shown on these reports. Replacing a broken trolley pole, for example, should not take over three or four minutes, but the reports frequently show delays of from 10 to 15 minutes from this cause.

It is a difficult matter to keep track of the oiling of such a large number of cars distributed over a wide territory

DAILY REPORT OF TRAIN DELAYS

DUE TO EQUIPMENT DEFECTS

Anderson Feb 27 1908

TRAIN NO.	CAR NO.	TIME OF DELAY	CAUSE OF DELAYS								REMARKS
			Motor	Trucks	Brakes	Co	rolley	Reliever	compressor	Wiring	

FIG. 3.—DAILY REPORT BLANK OF TRAIN DELAYS

and being frequently shifted to other runs and divisions. Formerly the cost of oil was as high as $1 per 1000 miles, but with the system now in use this has been cut down to 50 cents. A rack is provided in the motormen's vestibule of each car in which is kept an oiling record card (Fig. 4) printed on stiff paper. This card is never removed from the car until the blank spaces are all filled in, when it is replaced by a new one and the old card filed in the office of the superintendent of motive power. The number of the car is entered on the top line, and below are blank spaces for entering the place and date of oiling journals, motors and compressor with the name of the oiler. Journals are oiled every two weeks and motors and compressors from two to five days apart. When a car comes in for inspection the truck inspector looks at the last entries on the oiling record and if the required time has elapsed since the last oiling he puts in more oil, making the proper entries on the card. Whenever repacking is required in the judgment of the inspector it is done and entered on the record card. With this system there is no waste of oil and little chance of a bearing running dry from lack of attention. The limit of two weeks for journal bearings was determined upon after a number of tests, one car running in regular service for 28 days without oiling.

The repair shops at North Anderson are equipped to do all heavy repairing, overhauling and even building new cars if necessary. The accompanying plan (Fig. 5) shows the complete layout. The shop buildings are located on a triangular tract of land just south of the main power house

OILING RECORD

(This Card Must be Left With Car at All Times)

Car No......

STATION	JOURNALS	MOTORS	COMPRESSOR	OILER

FIG. 4.—OILING RECORD

and bounded on the west by Meridian Avenue and on the east by a mill race canal. The Anderson-Wabash division runs out Meridian Avenue and the shops are connected to these tracks by a diagonal ladder track along the east side, and a ladder track across the north end. A connection with the P., C., C. & St. L. tracks, which are west of Meridian Avenue, provides means for switching in coal and supplies to the shops and power house. The diagonal ladder track on the east side is connected to the ladder track across the north end with a curve of 77 ft. 6 in. radius and also by five parallel tracks running through the shop buildings, Nos. 1, 2, 3, 6 and 15. The arrangement of connections of the north ladder track with the Anderson-Wabash division tracks is such that cars back in on the ladder and head in on any one of the 18 shop tracks leading off the ladder. Cars entering from the south end over the diagonal ladder track also head in on the shop tracks. The turnouts from the north ladder are of 55 ft. radius and the ladder is 102 ft. from the building wall, so that the longest interurban cars can be headed into the building on a tangent track.

The shop is practically one building 300 ft. wide by 481 ft. long, the departments being separated from each other by fire walls. The construction is brick walls on concrete foundations with steel roof trusses and supporting columns. The main repair shop, 140 ft. 6 in. x 192 ft. 6 in., occupies more than half the width of the building across the north end. There are 12 pit tracks connecting with the ladder track outside and the tracks are extended across the truck aisle into the machine and armature shop space. The pits are 67 ft. long, 3 ft. 11 in. wide and 4 ft. 6 in. deep, built of reinforced concrete. Between the pits, which are spaced 16 ft. center to center, the floor of the shop is depressed 18 in. below the level of top of rail for convenience in making repairs to trucks. The blacksmith, machine and armature shops occupy the remaining space in the main repair shop. One track is carried across the building and out through the south wall separating the floor space of the machine and smith shops. The wheel storage space is along the east side of the locker room and this track affords

a convenient means of rolling mounted wheels into and out of the shop for shipment to inspection depots.

Adjoining the armature shop on the south is the main store room for shop, car and depot supplies. It is 80 ft. x 96 ft. and has a gallery running entirely around it for storage of light supplies. A depressed through track passes through the cleaning room, woodworking mill and adjoining auxiliary stock room, and supplies can be loaded or unloaded direct to or from cars on this track. The rails are depressed sufficiently to bring the floor of the car on a level with the floor of the store room. The auxiliary stock room, 81 ft. 6 in. x 60 ft., is used for storing heavy material, such as reels of wire, insulators, track bolts, spikes and fish plates.

white, which assists the lighting from a large skylight in the roof. The following machines have been installed: Band saw; rip saw; cross-cut saw; combined jig saw and single-spindle shaper; universal woodworker; two-spindle shaper; four-head tenoner; mortiser and borer; wood lathe; 4-in. x 8-in. molder; 8-in. x 24-in. four-cylinder surfacer, and automatic knife grinder.

On account of the liberal space allowed for the mill a convenient arrangement of the machines was possible and no machine interferes with the operation of another even when handling large stock. Carpenters' benches and tool cases are provided in one corner of the room. The lumber stock piles are adjoining the through track running into the mill room and lumber can be unloaded direct from

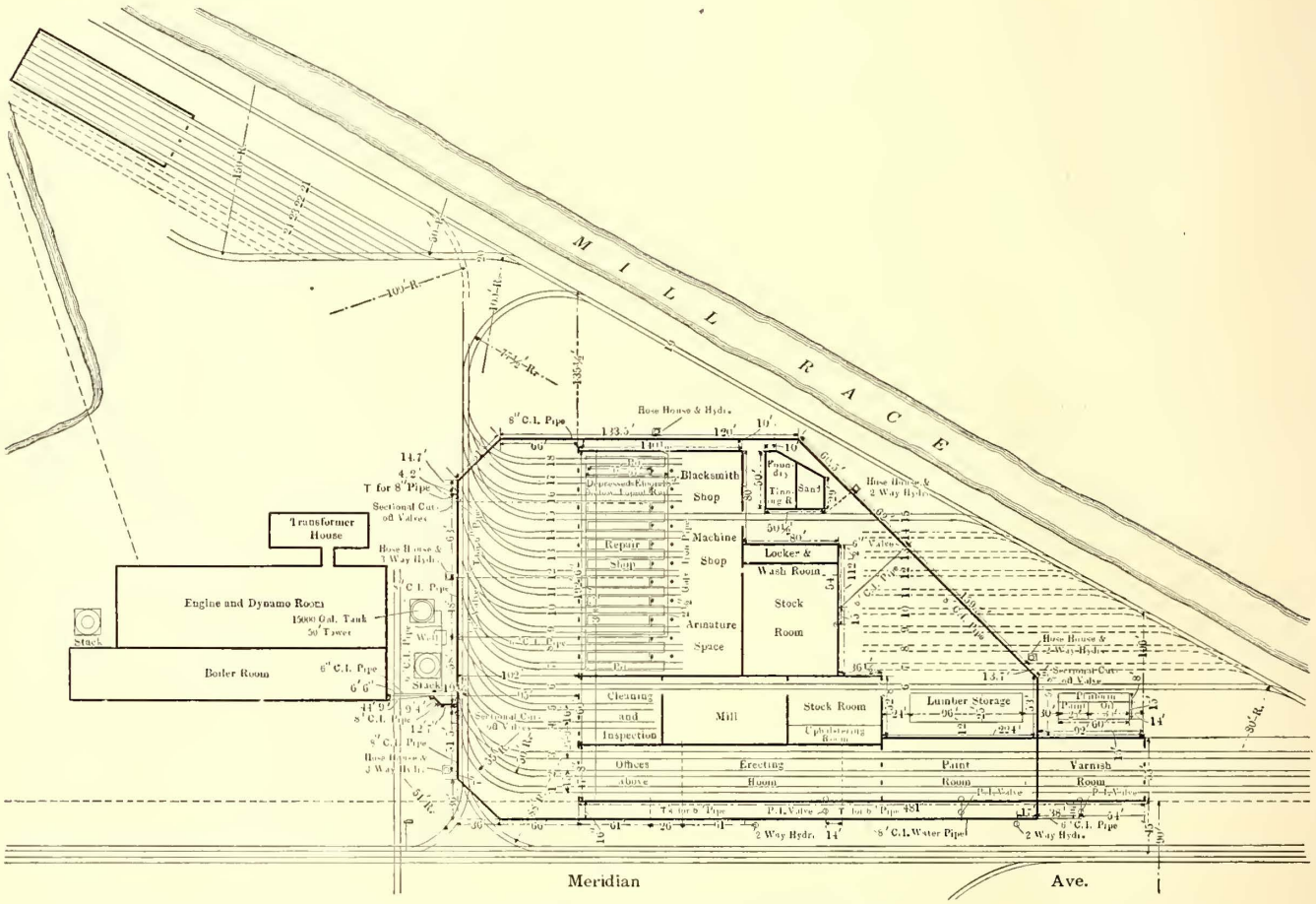


FIG. 5.—GENERAL PLAN OF THE ANDERSON SHOPS OF THE INDIANA UNION TRACTION COMPANY

There are two stub and one through tracks, already mentioned, in the cleaning and inspection room. The two stub tracks have pits 60 ft. long. This room is used for cleaning and inspecting the city and interurban cars cared for regularly at Anderson and for giving all cars which come into the shop for overhauling a thorough washing and cleaning. A portable combined compressed air and vacuum cleaning outfit made by the General Compressed Air Vacuum Machinery Company, St. Louis, Mo., has been installed for cleaning seat cushions and curtains and an attachment for washing the exteriors of cars.

Between the cleaning room and auxiliary stock room, and adjoining the car-building shop, which is along the west side of the building, is the woodworking shop or mill room, 60 ft. x 103 ft. 6 in. All of the machines are belt driven from overhead shafting turned by a Westinghouse induction motor. The floor is concrete and the walls are painted

freight cars in the mill or hauled from the stock piles on push cars.

The car erecting shop and paint shop are in one long building on the Meridian Avenue side and are separated from each other by a brick fire wall. The openings in the wall over each of the three tracks, which are continuous through the building, are closed by rolling steel doors. The erecting shop is 48 ft. x 260 ft. It has a concrete floor and is admirably lighted by high windows in the west wall and monitor skylights in the roof. The tracks are spaced 15 ft. center to center, giving ample room for working in the aisles between cars. Twelve of the largest interurban cars can be accommodated at one time here, allowing 65 ft. of length for each car.

The paint shop is 221 ft. long and 54 ft. wide, slightly wider than the erecting shop. It has a concrete floor and being an extension of the main building is lighted by win-

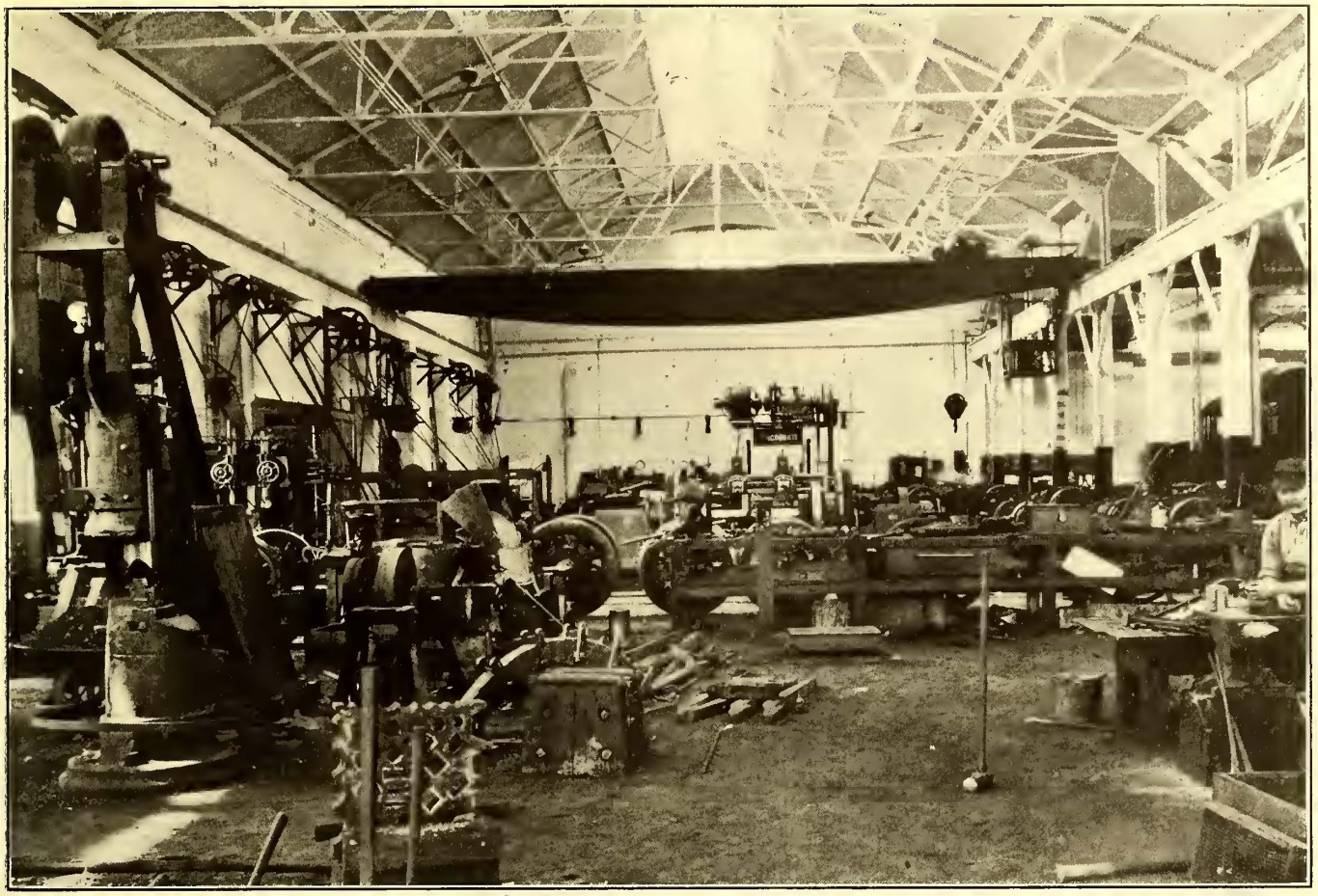


FIG. 6.—VIEW IN THE MAIN SHOP, SHOWING THE CRANE, FORGE EQUIPMENT, ETC.

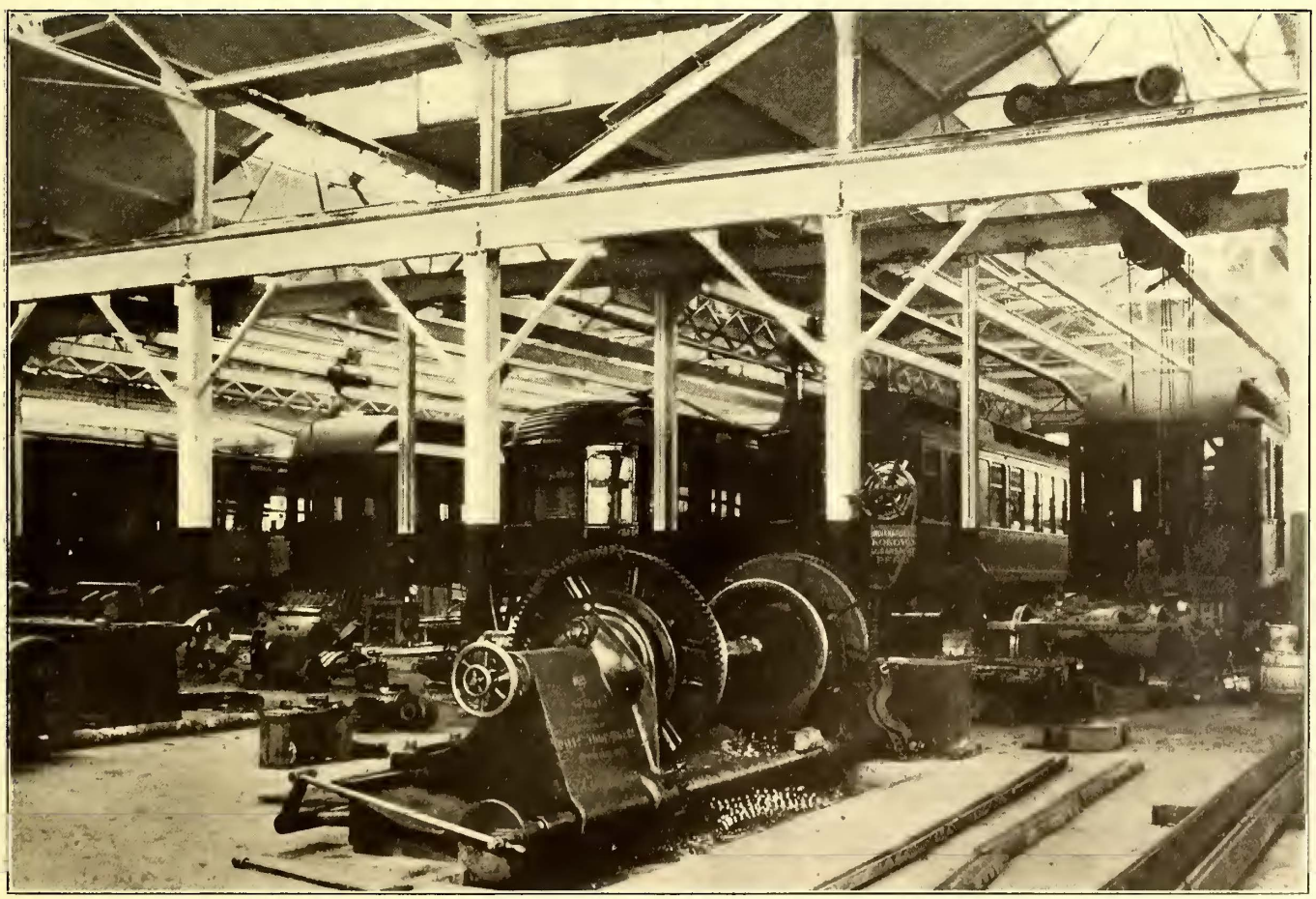


FIG. 7.—TRUNK AISLE AND REPAIR PITS, SHOWING TRAVELING BRIDGE AND MOVABLE HOISTS

dows on both sides as well as by a saw-tooth monitor in the roof. Oils and paint are stored in a separate brick building, 15 ft. x 60 ft., adjacent to the paint shop. An upholstering room, 16 ft. x 80 ft., is built between the paint shop and the auxiliary store room. This is used for repairing and varnishing window sash as well as renovating and repairing seat upholstery.

FIG. 8.—ARMATURE SHOP AND ARMATURE STORAGE RACK

Offices for the superintendent of motive power, superintendent of power, master mechanic and division electrician as well as a large instruction room for trainmen are provided in a second-story extension, 54 ft. x 64 ft., over the north end of the erecting shop. In a separate building south of the blacksmith shop are a brass foundry with two furnaces, a tin shop and sand drier and storage.

The shops are heated by the Evans-Almirall system of forced circulation of hot water, the supply being drawn from the power house. The heating coils are supported in banks on the bottom chords of the roof trusses in the store room, mill, paint and erecting shops. In the repair shop and cleaning room the coils are banked on the side walls of the pits where the warm air will rise and dry out the equipment standing over the pits. An extra large radiating surface is provided in the paint shop to assist in drying the paint when applied. The shops are lighted with Cooper Hewitt mercury vapor lamps with the exception of the paint shop, where inclosed arc lamps are used. The tubes are mounted well up in the roof trusses to get the maximum diffusion of light and have proved very satisfactory for night work.

When a car arrives at the shop for repairs it is assigned to one of the 12 pits in the main repair shop and inspected from trolley wheel to brake shoes for any and every defect, regardless of the division inspector's report of defects sent with the car. One man is employed who does nothing but this thorough inspection. The brakes, control apparatus and other electrical equipment on the car body are tested out and marked for overhauling if not in proper order. If any truck work is to be done the motors are uncovered and armatures removed for test

FIG. 9.—NORTH ELEVATION OF SHOPS, SHOWING LADDER TRACK

and overhauling if necessary. No detail of the car is overlooked.

If the trucks are to be removed for repairs to the motors or wheel work the motor connections are detached, brakes uncoupled and the body lifted off of the trucks by two 5-ton electric hoists. These hoists run on the lower flanges of 12-in. I-beams attached to the bottom chords of the roof trusses longitudinally between each pair of pits. One of these hoists is shown to the left of Fig. 6. Four of them are provided, and they can be shifted from one runway to another by the two traveling bridges which span the truck aisle at the end of the pits. The hoists are run on to short sections of similar 12-in. I-beams carried by the bridges below the lateral runway girders. One of the bridges with hoist attached is shown at the right of Fig. 6. When so mounted the hoists are used for lifting in the truck aisle.

After the car body is raised the trucks are worked out from under the car by pinch bars. This is heavy work, and an arrangement will shortly be put into use whereby it will be done by the assistance of the crane spanning the main shop. A rope will be attached to the truck and passed through a snatch block under the crane hook. By raising the crane hook the trucks will be pulled forward into the truck aisle. The same scheme will be used to replace trucks except that the rope will be passed around a snatch block at the back end of the pit before attaching it to the truck. When the trucks are removed the body is lowered on horses if no heavy carpenter work is to be done on it. If it is to be sent to the erecting shop for general overhauling or rebuilding it is mounted on shop trucks and shifted into the other building from which it is moved on into the paint shop for painting, varnishing, lettering, etc.

FIG. 11.—INTERIOR OF STOREROOM

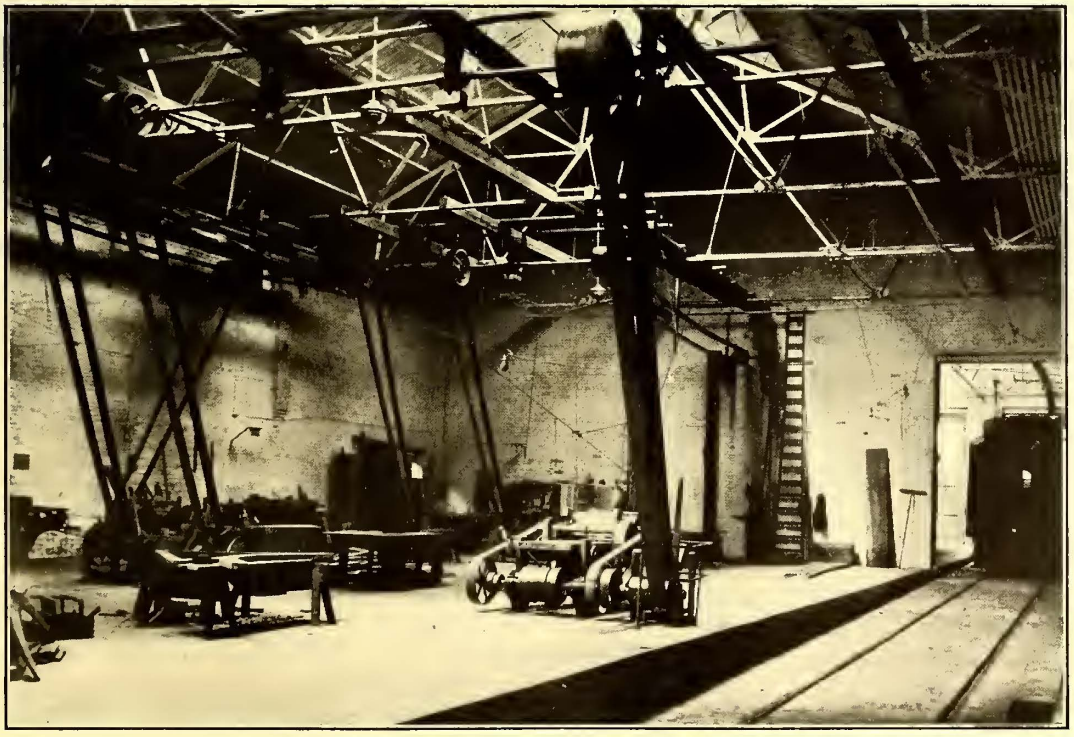


FIG. 10.—WOODWORKING MILL, WITH DEPRESSED TRACK LEADING TO THE STOREROOM

The shop has not been running long enough to have developed every detail of the system to be followed, but in general the scheme is to keep on hand spare trucks fitted up complete with motors and to substitute one or two of these whenever a car is shopped for truck or motor work only. The car can then be returned to service within a few hours without waiting for repairs to be made on the trucks removed. This is a development of the scheme now in use of keeping on hand spare wheels mounted on axles, spare armatures, controllers and other parts. The plan will eventually be extended to the inspection depots and complete trucks will be changed under cars instead of sending them to the main shop for such repairs.

The smith and machine shops are equipped to do any kind of work required in car repairing. In the smith shop are four Buffalo down-draft forges and anvils with a Beaudry belted power hammer for heavy work. The 15-ton travel-

ing crane which spans the entire shop is available for heavy work, such as truck frame straightening or welding. The machine shop equipment is also ample for the work to be done. It consists of the following: 42-in. Niles wheel lathe; 200-ton Niles wheel press; 36-in. Niles boring mill; 32-in. x 32-in. x 120-in. Cincinnati planer; 24-in. Cincinnati shaper; 24-in. Cincinnati radial drill; 20-in. Cincinnati radial drill; two sensitive drill presses; 36-in. x 10-ft. Bradford lathe; 24-in. x 8-ft. Bradford lathe; 14-in. x 6-ft. Lodge & Shipley lathe; 2½-in. Acme bolt cutter; circular metal saw; hack saw.

The wheel lathe and planer are driven by individual motors, but the other tools are all belt driven from sectional line shafting supported on the south wall of the shop. The wheel lathe, boring mill and wheel press are grouped together near the through track leading to the wheel storage space. The 24-in. Bradford lathe is placed along the wall at the armature end of the shop, where it is used for truing up commutators. All of the tools are served by the traveling crane.

The armature shop is fully equipped with a coil taping machine, field taping machine and banding machine. Some of the field coil winding and armature coil making is done by the employees at the inspection depots during spare time. A vacuum impregnating outfit is also to be installed. From 7 to 10 men are employed in the armature shop and they overhaul 37 armatures per month in addition to making field repairs and overhauling control apparatus. A stock of from 15 to 25 armatures is kept on hand in the floor rack shown in Fig. 8.

The shops work day and night shifts and on Sunday when required. On Sundays all interurban freight cars and express cars, 23 in number, are sent in for inspection and such repairs as are necessary. The foremen of the different departments report Sunday morning and if any of these cars require work to be done by the men in their departments they call out such men as are needed.

Since the new shops have been completed every interurban car is shopped on an average of about once in three weeks for some defect or another and receives a thorough overhauling and test before being run out. Before sending a car out it is thoroughly tested running in both directions at each speed on the tracks adjacent to the shops and in addition is gone over a second time by the inspector. Once every year each passenger car is taken in for thorough overhauling of woodwork, painting and varnishing. Cars in limited service are given this treatment every nine months.

FIG. 12.—INTERIOR OF PAINT SHOP; ANDERSON SHOPS OF THE INDIANA TRACTION COMPANY

The shops are in charge of R. C. Taylor, superintendent of motive power, to whom acknowledgment is due for the information from which this article was prepared.

A trial run was made Sunday, March 29, with the Strang gasoline-electric car Irene over the Pennsylvania Railroad between Jersey City and Philadelphia. The car left Jersey City at 1:24 o'clock, slowed down at Newark and stopped at Trenton and North Philadelphia, and arrived at Broad and Market Streets depot at 3:14. Deducting the time lost in stops, the trip was made in 1 hour and 45 minutes. The car has been described in these columns. It will be in the hands of the Pennsylvania Railroad for the next ten days, so that it may be thoroughly tested with a view, it is said, to its adoption by that company for use on a number of short lines.

BRAKE-SHOE DATA FROM BROOKLYN

Through the courtesy of the Brooklyn Rapid Transit Company, the following statistics are available on the consumption of brake shoes by that company during the year 1906: The total number of brake shoes applied on 3900 cars of all types was 72,455, of which 27,851 were required for the elevated division and 44,604 for the surface division. The elevated mileage during the same period was 26,355,589 miles, giving one shoe for about every 946 miles operated; on the surface division 42,619,086 miles were operated during the same period, giving an approximate average of one shoe to every 955 miles. The total weight of the new shoes used was 2,633,077 lb. and the total weight of scrapped shoes was 1,074,914 lb., or nearly 41 per cent. As the total mileage for 1906 was 68,974,675 miles, this gives 38 lb. of new shoes per 1000 car-miles and 15.5 lb. of scrap per 1000 car-miles.

Of all the shoes 61.2 per cent were of the M. C. B. or separable-head type; that is, all of the elevated shoes and 37 per cent of the shoes used on the surface cars during 1906 had the M. C. B. interchangeable head.

TOTAL NUMBER OF BRAKE SHOES USED DURING 1906

Month.	Elevated Division.	Surface Division.	Total.
January	2,669	3,684	6,353
February	1,736	2,645	4,381
March	2,315	3,855	6,170
April	2,087	4,667	6,754
May	2,793	4,787	7,580
June	3,118	4,731	7,849
July	2,738	3,996	6,734
August	2,500	3,847	6,347
September	1,365	2,350	3,715
October	2,256	2,890	5,146
November	2,305	3,789	6,094
December	1,969	3,363	5,332
Total	27,851	44,604	72,455

TRUING UP ROTARY COMMUTATORS

BY C. L. GREER.

All those who have anything to do with commutator machines know that it is sometimes necessary to turn or true up the commutator. With small machines it is a comparatively easy matter to remove the armature from its bearing and true up the commutator in a lathe, although it is best to turn the commutator with the armature turning in its own bearings. It is then true with reference to the bearings.

A generator which is directly connected to its own prime mover presents no serious problem in the matter of truing up the commutator. In this case it is only necessary to set up the turning device, adjust the speed of the engine or water wheel to that required and turn off the commutator. But the rotary converter is different. It must run in synchronism with and be driven by the alternators. In substations there are no means of driving a rotary at an independent speed.

The accompanying sketches show two methods by which rotary commutators may be trued up. The first is unique and so far as the writer knows has never been used except in the plant of the Northern Texas Traction Company, in which he is employed. This method requires a period of time when the plant may be shut down or else there must be a spare unit. The method is as follows:

The d.c. brushes on the machine to be turned are lifted from the commutator. This, of course, opens the field circuit, and the cutting tool is then set up and properly adjusted. The rotary is then switched on to the a.c. busbars which are not alive. The alternator—with a low field—is then switched on to the busbars and its engine slowly started. The rotary will start and run as an induction motor. The speed of the rotary may be adjusted by varying the speed of the engine, which is throttled down to a very low speed.

Fig. 1 shows the necessary connections. If the plant runs all the time and there is a spare unit a temporary circuit may be run as indicated by the dotted lines, with a switch at *A*, that the rotary may be quickly cut out if necessary. The

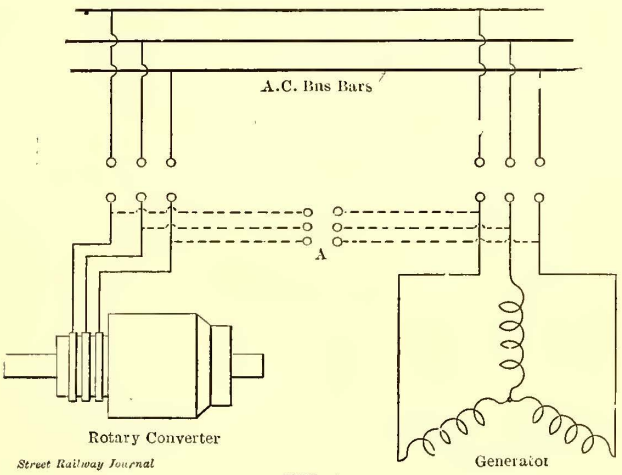


FIG. 1

current is comparatively large, although the voltage is low, hence the necessity of making the temporary circuit of ample carrying capacity. If the speed or voltage gets too high there will be some sparking at the point of the tool. This method has been used two years and works perfectly except for the sparking at the tool point. This sparking, however, does not seem to do any harm.

Where the plant runs all the time and there is no spare unit available, the method shown in Fig. 2 may be used. In

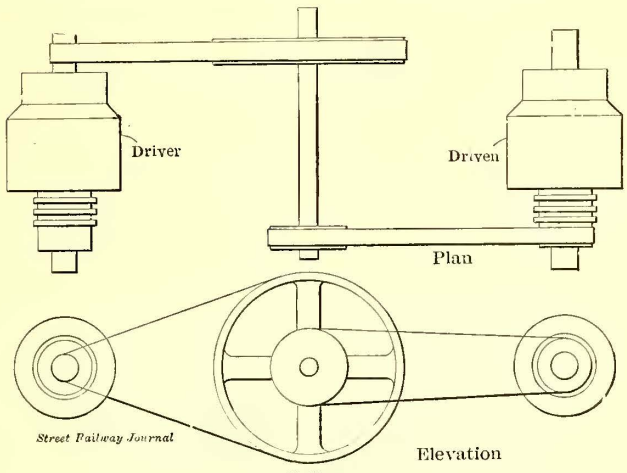


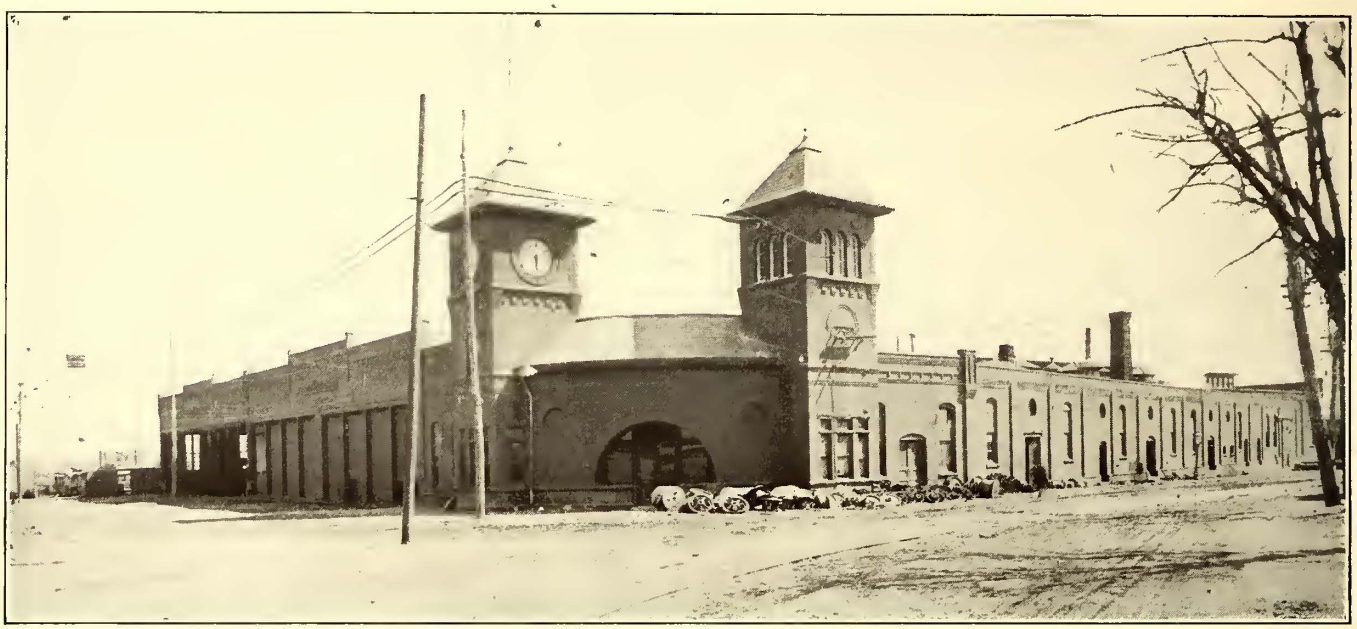
FIG. 2

this method one rotary is used to drive a shaft which in turn drives the rotary, the commutator of which is to be turned. This method may be used on a Westinghouse rotary, the shaft of which extends a sufficient distance from bearing housing to allow space for a belt. The rotary to be driven cannot be started from rest in this manner, but should be given a slight start with the current, then the belt may be applied and the rotary will continue to run. To try to start from rest will result in throwing the belts. Common wooden horses may be used to support the shaft bearings and clamps may be put on the shaft at the bearings to prevent end play. A piece of 3-in. pipe makes a good shaft to which to clamp wooden pulleys. The latter should be the proper size to give the required speed.

CHANGES IN SHOPS AND SHOP PRACTICE BY THE NEW YORK & QUEENS COUNTY RAILWAY COMPANY DUE TO THE ADOPTION OF ALL-STEEL CARS

The New York & Queens County Railway Company operates about 74 miles of track in and about Long Island City, which is directly opposite the central part of Manhattan Borough, New York. Hitherto the company has run ordinary wooden surface cars only, but owing to its forthcoming use of the Forty-second Street tunnels of the New York & Long Island Railroad Company under the East River all-steel multiple unit cars of surface type have been added to the equipment. At present the company is running 10 of these steel cars, and by May will have 50 in service. Of course, it is impossible to forecast the amount of traffic which the tunnel will carry at first, but as it will afford a direct and rapid route from the heart of New York to a large area of suburban territory, it will eventually carry enormous business. The operation of the steel cars will not be confined to the tunnel, it being planned to install them gradually on all important lines in Long Island City.

All of the rolling stock of the New York & Queens County Railway is maintained at the Woodside car house and shops, which are conveniently accessible from every part of the system. As these shops were built long before the day of steel surface cars, the management was confronted with the interesting problem of changing over an installation designed originally for wooden cars to one that would also handle an ever-increasing number of steel cars. In view of the novelty of the problem and the likelihood that steel cars are sure to find a wider field in the future, it is worth noting how the solution has been made.



FRONT VIEW OF THE WOODSIDE SHOPS OF THE NEW YORK & QUEENS COUNTY RAILWAY COMPANY, LONG ISLAND CITY, N. Y.

REAR VIEW OF THE WOODSIDE SHOPS OF THE NEW YORK & QUEENS COUNTY RAILWAY COMPANY, SHOWING SEPARATE BUILDING FOR OIL AND LUMBER STORAGE

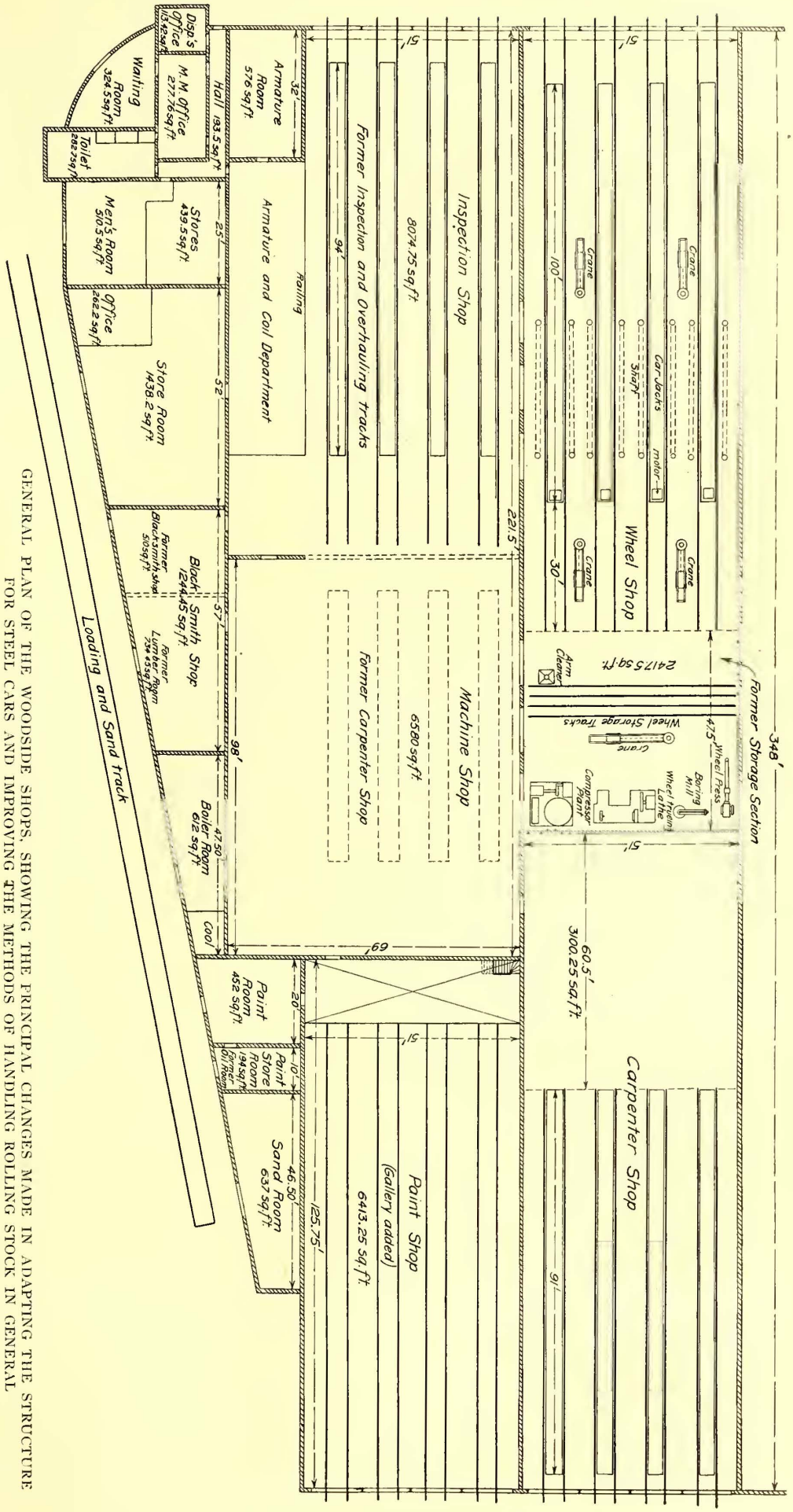
It was apparent, of course, that if the same structure was to be used there would have to be a radical reapportionment of the areas devoted to the different branches of work since the maintenance of a steel car-body would call for facilities of different character. At the same time the company desired to improve its arrangements for handling wooden

cars, so that the revised layout represents the fulfilment of a two-fold purpose.

The general plan of the Woodside installation as given in the accompanying drawing has been made to show the structural changes at a glance. Owing to the fact that this structure may be entered from either end, it has been possible to lay out each shop so that a car in for one purpose cannot be blocked by one in for another. This scheme also permits the company to reduce the risk from fire by walling in as many sections as feasible.

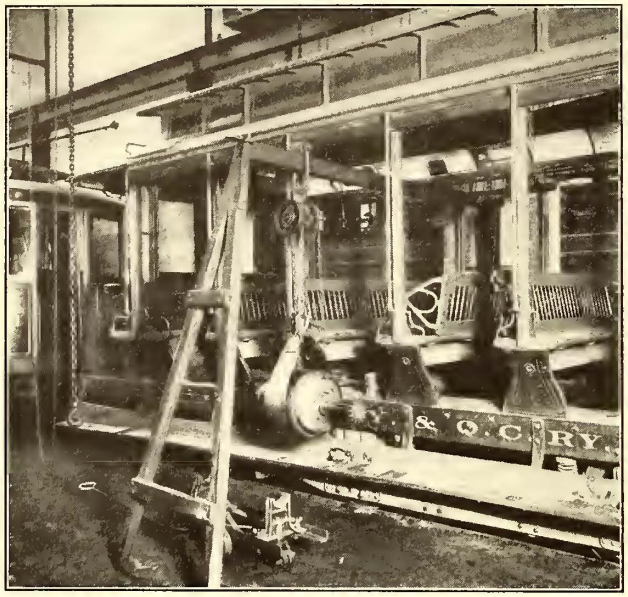
It was found that the general outlines of the structure could be left in the original condition except that in the new carpenter and wheel shops the door framing and lintel supports were altered to allow four tracks in place of five. The interior division walls, however, underwent considerable alteration, as will appear from the description. Twelve Wilson steel rolling doors were also installed, but some of the old swing wooden doors were retained as in the case of the paint shop, because of their large window area. The roofs of the wheel and machine shops were reconstructed to secure better lighting. Reference to the view of the machine shop will show what excellent illumination is now obtained. Arc lamps also have been installed for night use.

Considering now the general divisions of the buildings, it will be noted that the offices of the master mechanic and the dispatcher, waiting room, crew rooms and storeroom have not been changed in any important respect. The blacksmith shop, immediately adjoining the storeroom, has been enlarged from 510 sq. ft. to 1244.45 sq. ft. by adding the space formerly used as a lumber room. This change required taking down a 9-in. division wall and building two 8-in. pilasters for a new



GENERAL PLAN OF THE WOODSIDE SHOPS, SHOWING THE PRINCIPAL CHANGES MADE IN ADAPTING THE STRUCTURE FOR STEEL CARS AND IMPROVING THE METHODS OF HANDLING ROLLING STOCK IN GENERAL

roof girder. The new blacksmith shop opens on the street, on the machine shop and on the inspection shop. It is separated by 9-in. walls from both the storeroom and the steam-heating plant. The paint room and sand room have also remained unaltered. The paint room opens directly on the paint shop and also has a fire-door opening to the paint storage room, which was formerly used for lubricants. This last room is well isolated from the adjoining sections by 9-in. or 12-in. brick walls. The sand room has no connection with the paint storage room, but opens directly on the street to the sand track alongside.

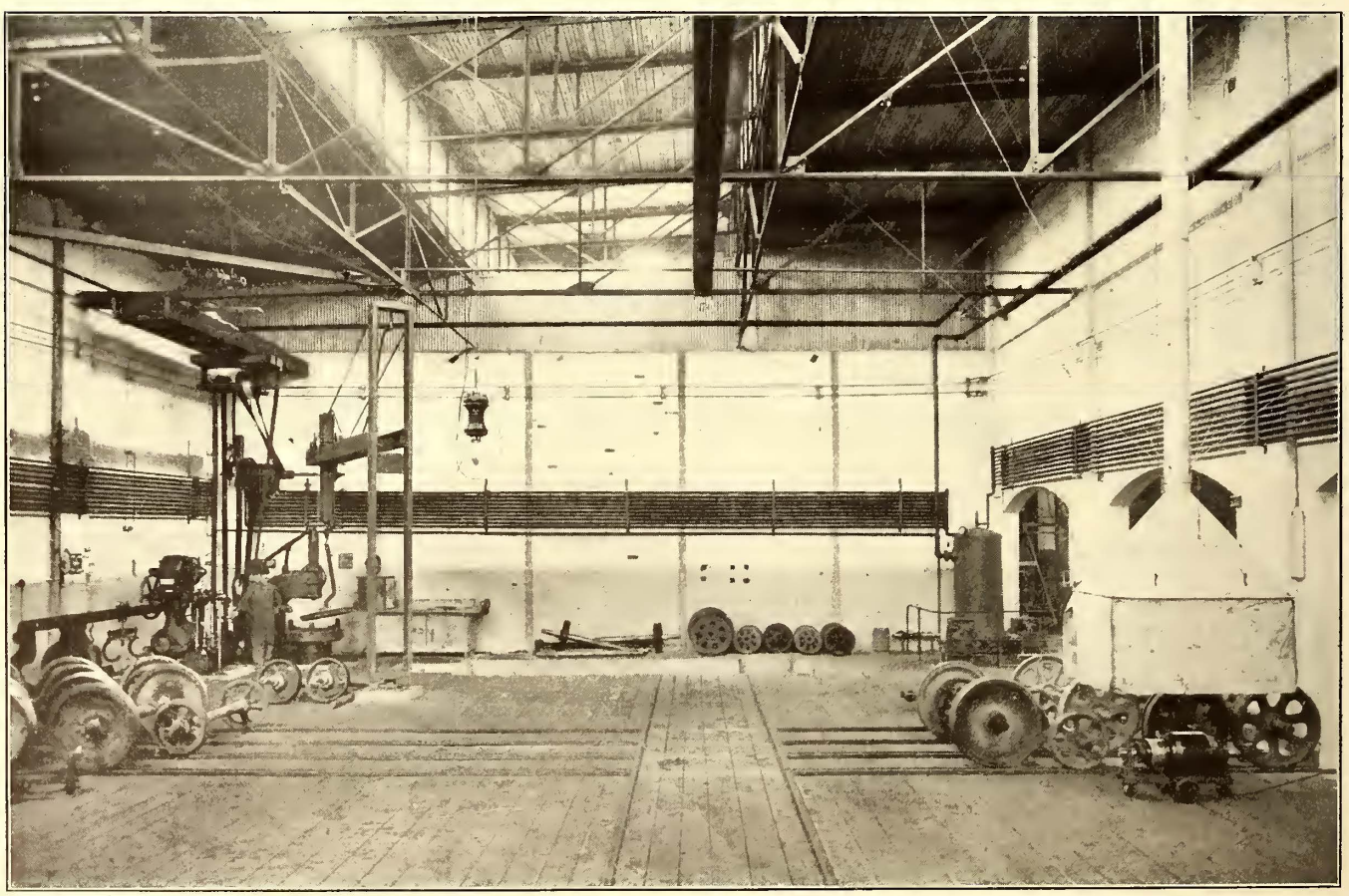


METHOD OF REMOVING ARMATURES FROM MOTORS ON OPEN CARS

The paint shop occupies exactly the same place and area as before, but its actual capacity has been increased four cars by constructing a concrete steel gallery, where all sash, door and sign painting is done. The gallery also offers an excellent observatory for the foreman, as otherwise it would be impossible for him to see much of what is going on when the shop is full of cars. The paint shop backs up on the new machine shop, from which it is separated by a 9-in. wall with one fire-door opening.

The old carpenter shop was between the paint and machine shops, but it is now more conveniently located in a four-track section opening at the rear. Under the old arrangement cars in the carpenter shop were greatly restricted owing to its location. The new carpenter shop occupies part of the space formerly used for car storage. There were formerly five tracks in this area, but the necessity for wider devil strips permitted only four tracks, each of which is furnished with a pit. The carpenter shop is separated from the new wheel shop by a solid wall consisting of a brick filling of an old steel partition across the former storage tracks.

The greatest extensions and improvements have been made in the machine shop facilities, the total area having been increased from 2150.5 sq. ft. to 8997.5 sq. ft. Reference to the plan will show that there are two machine shops. The smaller one practically is a part of the wheel shop, as most of the tools installed in it are for handling wheels and axles; the larger machine shop containing miscellaneous tools is in the center of the structure. This central machine shop occupies an area formerly used for the carpenter shop. In front of this shop there are still four inspection tracks with pits, but they have been made more accessible by tak-



VIEW OF WHEEL SHOP, BACK OF THE OVERHAULING TRACKS, SHOWING PNEUMATIC JIB CRANE SERVING THE BORING MILL

ing down the 9-in. wall which separated the old carpenter shop from this section. At the same time the track opening to the paint shop was bricked up because it was of no further use and its presence would needlessly increase the fire risk.

The new wheel shop is a four-track section adjacent to the inspection tracks and central machine shop, readily communicating with both of those sections through arches in the division wall. The wheel storage is between the overhauling tracks and the wheel and axle-handling machine tools.

It will be seen from the foregoing that the increase in the maintenance shop facilities has been secured by eliminating a five-track car storage section, 348 ft. long, and also removing the lumber and oil storage rooms. The latter are now located in an isolated brick building in the rear of the car house. The oil room is also used for trimming headlights which are stored in an old passenger car provided with shelves.

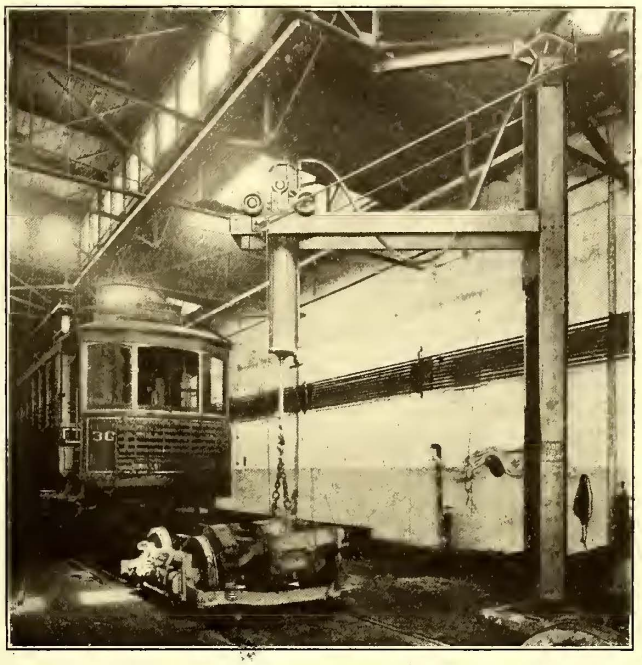
Indirect heating is used in the paint and central machine shops. The new carpenter and wheel shops, however, are steam heated, as the latter system is not only cheaper, but more satisfactory in this case because of the difficulty of getting clean air.

SHOP CHANGES AND EQUIPMENT

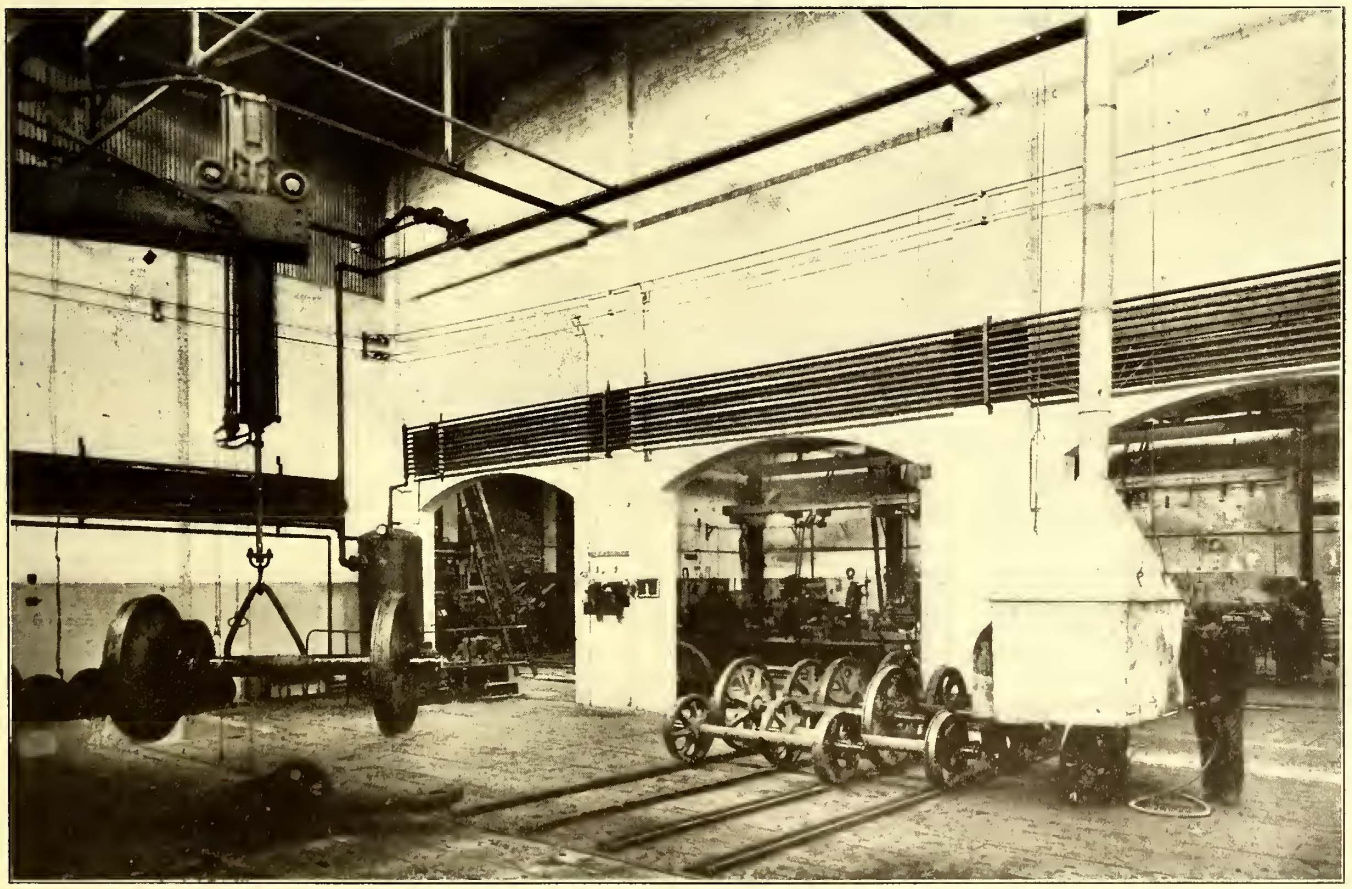
Aside from the rearrangement of the shops, the company has also made important improvements in the method of handling cars. The new steel cars, for example, have no trap doors and hence additional means had to be provided for hoisting car bodies in making motor repairs.

The great increase in the size of the blacksmith shop was made to allow the use of four forges, so that the steel cars can be maintained by repairing or manufacturing the necessary parts at home. The blacksmith shop also contains the following: One punch and shear, one 24-in. drill press; one bolt cutter; one 75-lb. trip hammer, and one 12-in. emery wheel.

The carpenter shop has a separate motor for driving the following tools: One 32-in. planer; one 12-in. planer; one



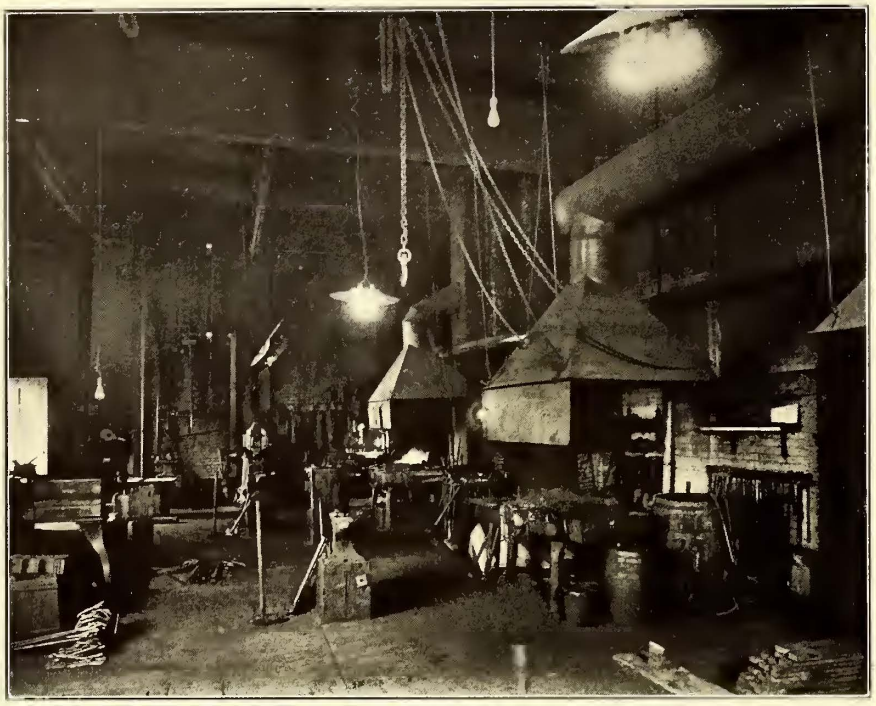
PNEUMATIC JIB CRANE LIFTING MOTOR FROM TRUCK



VIEW IN WHEEL SHOP LOOKING TOWARD MAIN MACHINE SHOP, SHOWING ARMATURE BEING CLEANED UNDER EXHAUSTER AND PENUMATIC JIB CRANE TAKING A WHEEL SET FROM STORAGE TRACKS TO TRUCK

band saw; one mortiser; one circular saw; one borer; one jointer; one variety molder, and two 24-in. grindstones.

As previously mentioned, the main machine shop is located in a central part of the structure formerly used for carpentry. The four tracks of this section were spanned by two 20-ton hand-operated cranes. As it was desirable to continue operating these cranes without interfering with the belted tools, the counter-shafting for the tools adjoining the old millroom has been placed outside the crane tracks, while the tools in the center of the shop are driven from belting carried through the covered pits. One of the cranes mentioned to be equipped with a 5-hp motor, which will do the work of four men usually required to operate it manually. An I-beam will also be hung from the crane track to facilitate the handling of armatures from trucks to lathes. The machinery comprises the following: Two 12-in. engine lathes; one 9-in. engine lathe; one 6-in. speed lathe; one 36-in. drill press; one 24-in. drill press; one 12-in. drill press; one 32-in. x 32-in. x 10-ft. planer; one 14-in. x 36-in. sharpener; one 20-in. emery wheel; one wheel grinder; one axle straightener, and one pinion press.



TWO OF THE FOUR FORGES IN THE BLACKSMITH SHOP

The section in front of this machine shop is used for inspection and miscellaneous car-body work. One of the illustrations taken in this shop show an interesting method of taking armatures in and out of open cars with a Yale & Towne triplex chain hoist. The outfit consists of a sling carrier with a rigid leg on the outside and a shorter adjustable leg on the inside of the car, the beam between forming a track for the roller from which the hoist and armature sling are suspended. The armatures are carried on a Columbia adjustable buggy. A mast and gaff arrangement operated with an air compressor is used for taking armatures out of closed wooden cars.

VIEW IN THE LARGE MACHINE SHOP, SHOWING THE EXCELLENT LIGHTING IN PARTICULAR

The new truck-overhauling or wheel shop contains four 100-ft. drained pits, all of which are wheel pits. An opening is left between the rails and devil strip for better access

to the trucks. The car bodies are electrically raised through Columbia screw car hoists driven by worm and miter gearing. These hoists carry an I-beam on each side, and one or both ends of the car can be raised by laying cross-bearers over the I-beams. Two motors are connected to one controller, but are independently operated by switches when desired.

The handling of trucks and wheels and bringing them to the tools placed behind these overhauling tracks is done with five pneumatic jib cranes furnished by the Quincy, Manchester, Sargent Company and located as shown on page 547. Four of these have air-balanced hoists each of 3600-lb. capacity, for picking up motors and other heavy parts, as illustrated. These hoists are operated at 80 lb. pressure, but can stand 110 lb. The crane itself is of double tie-rod construction with a lower pintle adjustable

LOOKING TOWARD THE OVERHAULING TRACKS, SHOWING THE LOCATION OF FOUR PNEUMATIC JIB CRANES AND THE METHOD OF RAISING CARS

for about an inch in any direction. The upper pintle has roller bearings. All the hoists are fitted in roller bearing trunnion trolleys.

The fifth hoist is of 2700 lb. capacity and is ideally located to care for a boring mill, wheel press and lathe, all of which are within the swing of this crane. As the wheel storage tracks are also within range, the great usefulness of this single tool can be appreciated. This hoist will retain the load indefinitely, which feature is obtained by a special valve construction. It also has a very slow speed for centering wheels on the machine tools and a fast speed for ordinary handling. One of the illustrations shows this hoist placing a set of wheels on a truck near the storage track and another view illustrates its usefulness in connection with the boring mill.

The principal tools in the wheel shop consist of a 200-ton wheel press, furnished by the Hydro Press Company, of Rochester, N. Y., which replaces a 100-ton press; a 40-in. Niles boring mill and a Putnam wheel lathe, which is now being installed on a foundation alongside the boring mill.

The plant for supplying the chipping hammers, riveting hammers, drills and air cleaning is located on the opposite side of the lathe foundation. This consists of two 50-cu. ft. capacity Christensen compressors and a 95-lb. pressure tank furnished by the Chicago Pneumatic Tool Company. Two compressors are used, so that one can do the work should the other break down. These compressors have semi-water-jacketed heads instead of having the whole cylinder water-jacketed.

Compressed air has been successfully applied to armature cleaning by the installation of an exhaust stack and hood in the wheel shop. The hood curtains, which are of canvas, can be lowered to encase the armature completely, so that no dirt will be blown around the shop, but be drawn up by the exhaust.

Among the smaller conveniences in the wheel shop are the Columbia armature buggy and pinion puller. The latter has been mounted on a truck to permit its quick use at any desired point.

The armature room contains one field-winding machine, one banding machine and a 1000-lb. hand traveling crane.

REPAIR AND LUBRICATION PRACTICE

The company is now inspecting cars on a 900-mile basis and overhauling them about every 30,000 miles. The results of the mileage method have already appeared in a reduction of night work.

An important change has been made in the brake design of the Brill 27-G trucks operated by this company. A piece of angle iron has been substituted for the link hangers running from one pedestal to the other. The brake beams

rest on the angle iron, and as lost motion is avoided the brake shoes can now be worn down to ⅛ in. and better braking secured. This innovation also strengthens the truck frame and prevents the brake rigging from dropping.

Lubrication is carried out under a contract with the Galena Signal Oil Company, which designed a special oil cup to be set in the grease cups originally used with GE-800 motors. Since the adoption of the Galena system the armature mileage has greatly increased and no armature has been lost through hot bearings. Hot journal bearings do not average more than one a month. Two men were needed with grease lubrication, but the adoption of oil and the use of the mileage system have cut the labor charge in half. The cars are oiled about every 500 miles, corresponding to three days' running.

Oil instead of grease is used for the side and center bearing plates. The lubricant is applied by boring holes in the car floors and inserting ½-in. and ¾-in. tapered tubes for the center and side bearings, respectively, the tubes being filled with saturated wool waste and screwed in at the top. These tubes are refilled about every 900 miles. This method

New York & Queens County Railway Co.

PULL-INS

_____ 190

CAR No.	TIME	CAUSE	MOTORMAN	BADGE No.

PULL-IN RECORD BLANK

WRECKING CAR REPORT.

_____ 190

Time	Place	Car No.	Remarks

CREW _____

DAILY REPORT BLANK FROM CREW OF WRECKING CAR

New York & Queens County Railway Co.

Carpenter Shop Report

Car No.	When Commenced	No. Men Striping	No. Men Overhauling	No. Men Trim.	Finished

Foreman.

New York & Queens County Railway Co.

Paint Shop Report

Car No.	When Commenced	No. Men Scrubbers	No. Men Painters	Finished

Foreman.

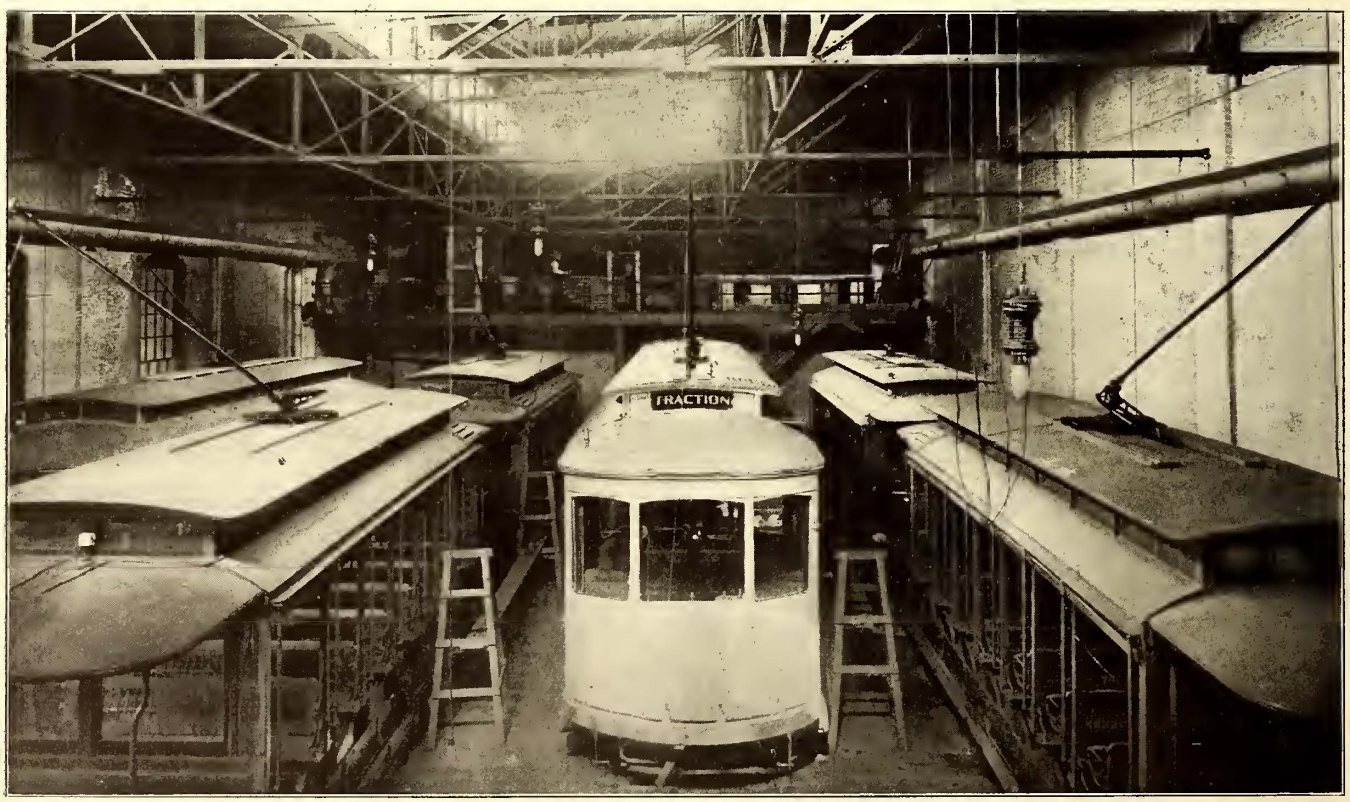
New York & Queens County Railway Co.

Overhauling Shop Report

Car No.	When Commenced	Finished	No. of Men

Foreman.

REPORT BLANKS FROM THE SHOP FOREMEN TO SUPERINTENDENT OF MOTIVE POWER



IN THE PAINT SHOP LOOKING TOWARD THE STEEL AND CONCRETE GALLERY

permits the plates to be lubricated continuously, since the advantage of having a constant supply of oil prevents wheel wash from affecting them.

RECORDS

The duties of the superintendent of motive power of the New York & Queens County Railway Company cover a wide range, but through the use of a few simple forms he

New York & Queens County Railway Co.

REPORT OF INSPECTORS.

*Car No.*_____ *Date*_____

*Brakes and Truck*_____

*Controllers*_____

*Motors*_____

*Car Wiring*_____

*Carpenter*_____

*Air Brakes*_____

INSPECTION FORM SIGNED INDIVIDUALLY BY MEN WORKING ON A GIVEN CAR

can keep in constant touch with the different departments in his care. The pull-in record, for instance, shows immediately what cars and motormen are having the most trouble, while in another way the wrecking-car report is a good gage on the condition of the equipment and the causes of breakdowns.

The condition of work in the shop is known to him through the daily reports from the foremen of the inspection, wheel, carpenter and paint shops. These show how many cars are in each shop and give a guide to increase or decrease of the shop force according to the need for the cars. The inspection foreman also turns in every day the individual reports on cars inspected. These reports must be signed by the men doing each class of work indicated, so that responsibility for poor work can be traced at once. These forms are placed in a tin box hung from the dash of the car in for inspection, and when duly signed are collected by the inspection foreman.

Shop orders are made out by the superintendent of motive power in duplicate, and after the job has been completed, a signed slip to that effect is turned in by the proper foreman. Emergency work coming in from the road is treated as special, but the foreman must turn in a report afterward.

Stock records are kept by the storekeeper, who must send a daily report to the main office showing the distribution of material under the heads indicated in the accompanying reproduction, while the records of oil consumption are checked on a standard Galena stock chart. Material is given out only on requisitions honored by the respective foremen. The employees' time cards are marked with the proper account number and rate of payment and then sent to the main office, where the pay rolls are made out.

The mileage record of cars is kept in a book and is based on trip data supplied by the transportation department. A red line is drawn under the last mileage indicated whenever the car is overhauled. Another book record kept by the superintendent of motive power shows for what equipment defect a given car was sent to the shops and who changed the brake shoes, renewed the axle bearings or performed other work. Dates only are given in this book, but reference to the mileage-book record of the same car will show the mileage made up to the time the car was shopped.

EMPLOYEES' BENEFIT ASSOCIATION IN ATLANTA

Purely with a view of aiding its employees as much as possible, the Georgia Railway & Electric Company was instrumental in organizing the Georgia Railway & Electric Employees' Association. Like all similar bodies, it is based on the theory that while one cannot help many, many can help one. Cases would come up from time to time where help was needed for an unfortunate employee and the men would voluntarily contribute toward a fund started by some one connected with the company who was more or less personally interested in the object of the charity.

While the association was not started until after the first of the year, the employees are taking an active interest in it and everything augurs well for the success of the undertaking. Membership is limited to physically sound employees of the company between the ages of twenty-one and fifty. Briefly the purposes of the association are to promote good fellowship among the employees, to aid the members when they are sick and to contribute to their designated beneficiaries in case of death. The dues are 50 cents a month, payable in advance. The right is reserved to levy an assessment, however, in case the funds of the association are not sufficient to meet the obligations, but this assessment, it is provided, shall never exceed 50 cents in one month or $2 in any one year. A reserve fund is to be created of $500 for each 100 members or fraction of a hundred, this fund to be kept intact and free from indebtedness. When the reserve exceeds this sum the surplus may be divided among the members in equal shares, those to participate in such division being members of more than one year's standing.

The management of the association is vested in a board of trustees consisting of a chairman and eight members. The president of the association acts as chairman of the board of trustees. Three members of the board are appointed by the vice-president of the company, the other members being elected by vote. The association employs a doctor to visit sick members without cost to them and also furnishes their medicines free of cost. There are also visiting committees who go about from day to day looking after such members as need help. Members of the association do not draw any benefits until after they have been disabled for five days. The benefit paid is $1 a day, with a maximum payment within one year of $90. One hundred dollars is the sum paid in case of death.

STOREKEEPER'S DISTRIBUTION OF MATERIAL

CARS

MATERIAL	QUANTITY	RATE	Steam Plant	Electric Plant	Carpenter Work	Iron Work	Repainting	Revarnishing	Signs	Air Brakes	Wheels	Axles	Brake Shoes	Fenders	Misc. Truck Repairs	Total

ELECTRIC EQUIPMENT OF CARS

Armatures	Fields	Commutators	Controllers	Car Wiring	Trolley	Waste	Axle Bearings	Armature Bearings	Gears	Pinions	Heater & Light Circuits	Misc. Motor Repairs	Total

OPERATION OF CARS

Miscellaneous Equipment	Shop Expenses	Total	Wages of Car House Employees	Car Service Supplies	Miscellaneous Car Service Employees	Cleaning and Sanding Track	Removal of Snow and Ice	Total	Car Equipment	Motor Equipment	Power House Equipment

THE CAR DEFECT RECORD SYSTEM OF THE BOSTON ELEVATED RAILWAY COMPANY

During the past two years a system of reporting and investigating car defects has been in use on the Boston Elevated Railway Company's lines which has given unusually interesting and suggestive data to the maintenance organization. It has also tended to reduce failures on the street and decrease the amount of repairs required on the rolling stock. The reduction of total failures in service from 4099 in November, 1905, to 1705 in February, 1908, speaks for itself, and a study of the methods in use and the effect that this analysis has had upon particular troubles from month to month prove the value of the system without reference to other conditions.

On Sept. 30, 1907, the Boston Elevated system consisted of a total surface track mileage of 446, and an elevated track mileage of 16. The total number of revenue passengers carried during the year was 271,084,815, and the car mileage from which revenue was derived was 52,061,569. To handle this traffic 3402 passenger cars were in the company's possession, and the total number of electric motors owned was 5137. The present article will be devoted to the car defect system as used on the surface lines of the company. A somewhat similar system is employed on the elevated division.

The maintenance of rolling stock is conducted at the 25 car houses of the company, in the car shops at Bartlett Street and in the general machine shops at Albany Street. The work at the car houses themselves is confined almost entirely to running repairs. For general overhauling, the cars are sent to the shops. All maintenance is under the jurisdiction of the superintendent of rolling stock and shops, who reports to the chief engineer of motive power and rolling stock. The latter is responsible to the vice-president. In general, car body repairs, including painting and wiring, are handled at the Bartlett Street shops. All other repairs are made at the Albany Street shops.

The organization in effect at the different car houses varies somewhat, but in general the operation of the cars at each car house is in charge of a starter, who reports directly to a division superintendent, and the repair work is under a car house or pit foreman, who also reports to the division superintendent. The motormen and conductors when in the house are responsible to the starter, and on the street to the division inspectors. The pit foreman has supervision over the car inspectors or repairmen, among whom is a blacksmith in each house. Car cleaning is considered as belonging to the operating department and is under the direct charge of the starter. All maintenance matters are under the supervision of the division superintendent, who, in the regular course of business, refers them to the office of the superintendent of rolling stock and shops.

The reports and records that form the basis of this article start with the trouble slips turned in by the motormen to the starters when a car has to be pulled in from its run for a defect. A trouble is considered a defect when a car has to be pulled in before the end of its run, or when it has to

Form 0092. 6-1-50m.

BOSTON ELEVATED RAILWAY COMPANY.

Defects Noted in Car ....

Date .... 190 Time .... M.

By Conductor .... No. ....

By Motorman .... No. ....

BODY.		BODY.		ELECTRICAL.	
Bell	......	Trolley Catcher	......	Bucking	......
" Cord	......	" Cord	......	Cable	......
Cards; Adv & Pub	......	" Pole	......	Charged	......
Curtain	......	" Springs	......	Circuit Breaker	......
Cushion	......	" Wheel	......	Controller	......
Dasher	......	Ventilators	......	Fuse Box	......
Door, Car	......	**MECHANICAL.**	......	Fuses	......
" Op Device	......	Air Brake Fuse	......	Headlight	......
" Vestibule	......	" " Switch	......	Heaters or Switch	......
Draw Bar	......	" Gauge	......	Main Motor Switch	......
" " Rest	......	" Compressor	......	Master Controller	......
Fender	......	" Pipe Leaking	......	Motor	......
" Castings	......	" Valves	......	" Flash	......
Floor	......	Axle	......	" Suspension	......
Glass	......	Brake	......	Lamps	......
Gong	......	" Dog	......	Lead Wires	......
Grab Handle	......	" Handle	......	Lt. Switch or Fuse	......
Hand Strap or Rail	......	" Rod	......	Pump Governor	......
Lifeguard	......	" Shoe	......	Relays	......
Register Cord	......	" Staff	......	Resistance	......
Reg. Cord Hanger	......	Gear and Casing	......	Reverser	......
Roof Leaks	......	Hot Box	......	Rheostat	......
Running Board	......	Shaking	......	Sign Lights	......
Sand Box or Spout	......	Snow Scraper	......	......	......
Seats	......	Springs, Journal	......	......	......
Side Bar	......	Squealing	......	......	......
Signs	......	Wheel	......	......	......
Step or Hanger	......	......	......	......	......

MISCELLANEOUS AND NOTES.

Derailed .... **Slow** .... **Dirty** ....

A Conductor or Motorman observing any defect while running a car must fill out this form and at once turn it in to the Starter or Station Master in charge of station.

A check mark in space opposite any defect noted is sufficient, thus X.

FIG. 1.—CREW'S REPORT ON CAR DEFECTS

BOSTON ELEVATED RAILWAY COMPANY. **DEPT. MOTIVE POWER AND MACHINERY.**

CAR NO. TABULATION OF MILEAGE, JANUARY 1908. TO JANUARY 1st. 190

Date	Jan.	Feb.	March.	April.	May.	June	July.	August	Sept.	Oct.	Nov.	Dec.
1	2684	2611										
2	2617	2673										
3	[illegible]	2624										
4	[illegible]	[illegible]										

FIG. 3.—UPPER PART OF MONTHLY MILEAGE TABULATION

Form 707 C 100-3-06 BOSTON ELEVATED RAILWAY CO. DEPT. MOTIVE POWER & MACHINERY.

TABULATION OF ALL CAR BODY TROUBLES MONTH OF February 1908

	Grove Hall	Forest Hills	Dorchester	Lenox St.	Sewall St.	Jamaica Pl.	Park St.	Neponset	Milton	E. Boston	North Pt.	Chas. Neck	Salem St.	Everett	Murray St.	Watertown	Mt. Auburn	Clar Hill	Arlington	North Camb.	River St.	Summer St.	Allston	Oak Sqr.	Reservoir	Total
Roof			1				1					1							1							4
Outside Body				2							1			1		1		1			1					7
Floor and Platform																		1	1					1		3
Vestibule-Dasher	5		1	5	1		3		6			2		1		2	1	3		1	8			2		34
Window and Door Frames				1		1			2								17	1								22
Glass	31	11	10	29	22	20	7	2		12	23	14	3	3	16	12	3	23		9	11	17	2	9	7	296
Steps and Grab Handle	5	2		3	1	1				2	7	5	1		2	1		1	1	3	1			1		37
Lamps and Sockets												1	3			5				1				1		11
Light Switches										1												1				2
Light Fuses																	1									1
Heater Coils	1			1			2		1	3		3	2	1	3					1		1				19
Heater Switches																										0
Heater Fuses											1	1			1					1						4
Gongs, Bells, Cords, Hng's				1		2					1	5			1	1		1		2						14
Registers, Cords, Hangers				2	1					1		2					1			2						9
Fender and Draw Bar	5			6	5	1		1		6	1	3	5	2	1	7				2	1		1	3	1	51
Wiring				1							1		1			1						1				5
Sand box								2		2										1					1	6
Pneumatic Doors					5					12			3													20
Trolley Catcher and Cord		1																								1
Misc. Bolts																										0
Seat										1		1	4													6
Total	47	14	12	51	35	25	12	5	9	40	35	38	22	8	24	30	22	31	3	23	17	20	3	17	9	552

FIG. 5.—TABULATION OF CAR BODY TROUBLES

BOSTON ELEVATED RAILWAY COMPANY.

Weather Rain A. M. Grove Hall Car House DAILY REPORT. 6 A. M. to 6 P. M. [illegible] 190 Weather P. M.

CAR NO.	TIME IN	TROUBLE REPORTED	TROUBLE FOUND	REPAIRED BY	Time Repairs Completed	CARS FOR INSPECTION		REMARKS
[illegible]	7.15 am	Motor	[illegible] No. 1 motor	[illegible]	9 am	78	578	
740	11.15 am	Fuse	[illegible] No. 2 motor	[illegible]	2 p.m.	80	1089	
						88	510	
						283	1763	

FIG. 2.—UPPER PART OF LOG SHEET

be held for repairs over the time when it would go out on its next regular trip. Fig. 1 shows one of the slips used by motormen, the original being 3⅞ in. x 7¼ in. On this slip a defect is checked against the apparatus that the motorman deems to be in trouble, and the slip is turned in to the starter as soon as the car reaches the house. The car is then placed on the proper pit or inspection track and it is not taken out again until the trouble is remedied.

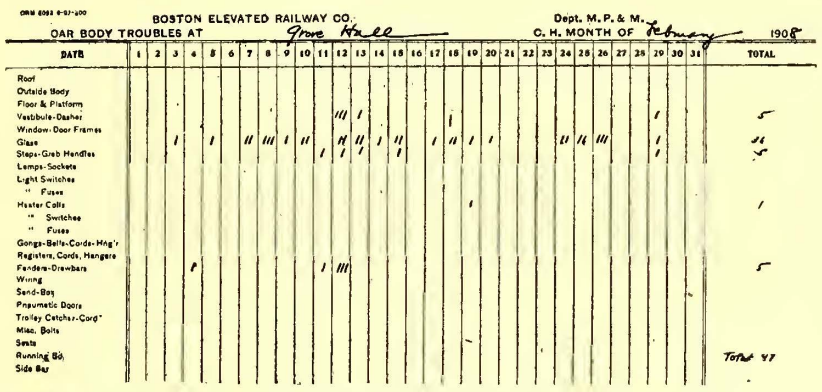
From the motormen's trouble slips the car house foreman makes up a daily log sheet, corrected if necessary by the report of the man who makes the actual repairs. The trouble is not always properly located by the motorman, and its actual cause may be other than that reported. In either case the correct trouble is carefully written on the log sheet, size 8 in. x 18⅜ in. (see Fig. 2). These log sheets are sent daily to the office of the superintendent of rolling stock and shops, and form the basis of all subsequent classifications of defects. The clerical work required to keep up this system is simply that of one clerk at the office, who gives his entire time to it, supplemented by about one-half hour's time a day at the car house by each of the foremen. The log sheets are tabulated by car houses and classified according to the nature of the defect on standard cards about 5 in. x 8 in. These daily records are turned into monthly records and the car-house records are consolidated into a report that shows the number of the various kinds of failures and the number of failures of the various kinds of equipment or motors. These statistics are then again classified on a mileage basis. The final classification shows the general nature of the defects and allows their investigation, pointing the way to their prevention or reduction.

All troubles are classified under the following general headings: Car body, motors, control, trucks, brakes and trouble reported and "nothing found." Under each of these general headings are sub-divided the parts of the equipment in which the various troubles occur. The log sheet provides for a record of the time and name of the employee who makes the repair, so that it is an easy matter to determine the cost of any trouble as well as the time a car is held out of its regular schedule trips. A regular inspection of surface cars is made at the end of each 300 miles run, and the numbers of the cars attended to by the inspectors are indicated on the log sheets each day. Accident reports affecting cars are also placed on this log sheet.

An example of the mileage record as kept at separate car houses is shown in Fig. 3. The originals of these cards are 9⅜ in. x 7½ in. and show a space for the mileage of each car by months. Individual cards are also provided for the cars, showing the mileage on a daily basis. These mileage figures are obtained by taking the number of trips made by each car from the trip register sheets, and then deriving the actual mileage from tables which have been prepared for each route. The mileage figures thus secured are entered, with the date, for each car on the car cards, but the figures are not added until the total mileage is required.

Fig. 4 shows a typical car body trouble card for the Grove Hall car house for the month of February, 1908. Twenty-four trouble items are provided for, including the fittings of the car proper, heaters, fenders, drawbars, etc. The occurrence or absence of each trouble by days is shown. Thus in this month there were a total of 47 car body defects at Grove Hall, the breakage of glass being the most frequent trouble. Vestibule, dasher, fender and drawbar troubles practically made up the balance. The arrangement of the record in this way enables the company to see just how frequently any particular defect occurs, and how they run on any particular day, taken in relation to weather or other conditions of which records are kept elsewhere.

Fig. 5 shows the tabulation of all car body troubles on the surface line in February, 1908. This record is made up from the separate car house records just instanced, and enables the different houses to be compared. In the monthly meetings of car house foremen these comparisons provide the matter for very valuable discussion. In February there were, all told, 552 car body defects, of which glass breakage accounted for 296. Heater switches and miscellaneous bolts were the only parts of the apparatus listed which did not require entering during the month selected. The maximum number of defects occurred at the Lenox Street car house and the minimum at Arlington and Allston. Vestibule and dasher troubles, fender and drawbar defects and troubles with steps and grab handles, window and door frames, heater coils and pneumatic doors were the other principal items. The maximum number of glass


BOSTON ELEVATED RAILWAY CO.
CAR BODY TROUBLES AT Grove Hall
Dept. M. P. & M.
C. H. MONTH OF February 1908

DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL
Roof																																
Outside Body																																
Floor & Platform																																
Vestibule-Dasher												///	/					/											/			5
Window-Door Frames																																
Glass			/		/		//	///	/	//		//	//	/	//		/	//	/	/				//	///			/			11
Steps-Grab Handles											/	/	/		/														/			5
Lamps-Sockets																																
Light Switches																																
" Fuses																																
Heater Coils																			/													1
" Switches																																
" Fuses																																
Gongs-Bells-Cords-Hng'r																																
Registers, Cords, Hangers																																
Fenders-Drawbars				/							/	///																				5
Wiring																																
Sand-Box																																
Pneumatic Doors																																
Trolley Catchers-Cord																																
Misc. Bolts																																
Seats																																
Running Bd.																																
Side Bar																																Total 47

FIG. 4.—MONTHLY REPORT OF CAR BODY TROUBLES

troubles occurred at Grove Hall, while the Mt. Auburn car house had far more trouble with window and door frames than all the other houses put together. By comparing these cards from month to month the company can check the occurrence of any trouble very quickly in case it becomes excessive and is amenable to control. In a certain month one car house may have an undue amount of heater defects; if it does, the fact will at once be shown by the card record, and steps can be taken to find out what is the cause. Improvement in any trouble item appears just as quickly.

Control troubles are listed in the same way in 25 items, the headings being:

Control cylinder, control finger burned, control finger broken, control finger adjustment, control springs, control flashed, resistance grid, resistance ribbon, main motor switch, trolley pole-fork wheel, trolley leads, master controller spring, master controller switch, contactors interlocks, reverser fingers, reverser plates, relays, wiring, fuse box, rheostat, circuit breaker, connection board, lightning arrester, magnet.

During February last the total control troubles were 273. From an operating standpoint it is interesting to note that the largest number was under the heading of resistance grid troubles, which reached the total of 58. Only four car houses escaped this trouble and several had an average

of over one a week. For a system operating 1500 cars this is not, of course, a very serious state of affairs, but the figure is taken to illustrate how every kind of defect at once appears on the record system in use. The other principal causes chronicled in this particular month were trolley pole, fork or wheel defects (37), control flashes (35), control finger and cylinder troubles (45) and car wiring (30).

A comparison of these items from month to month is not a matter of approximation with these records. It is interesting to note that one car house, Allston, did not have a single case of control trouble in February. In every kind of trouble the card record affords a sound basis for the starting point of an investigation in case the company's officers deem it necessary. If the control defects in toto are more in any one month than in the preceding month or the corresponding month of a year back—in comparison with any selected period, in fact—it is a simple matter to start a line of investigation. Where the trouble is directly attributable to the apparatus, the existence of these reports permits the company to take the matter up with the manufacturers in a satisfactory manner. Definite and specific instances of defects can be quoted instead of a more or less general statement of trouble.

Brake and truck troubles at the separate car houses are tabulated on a similar set of cards, also 5 in. x 8 in. These need little comment except to give the items listed. On the brake cards, the troubles experienced with hand brakes are separated from those with air, so that the causes of defects can be run down more quickly. The titles follow:

Brake Troubles: Handle, staff, rods broken, rods bent, levers, chains, hangers, rubbers, hose, shoes, adjustment, brakes sticking, miscellaneous, pump governor, governor pipe, compressor fuse, compressor armature, compressor cage, miscellaneous, triple valve, motorman's valve, brake cylinder, piping, whistle, gage, valves.

Truck Troubles: Truck frame, axles broken, axles and other than broken, wheels, gears, center bearings, side bearings, suspension bars, journals, derailed, miscellaneous, scraper, life guard.

Form 707 L 500-3-06 BOSTON ELEVATED RAILWAY CO. DEPT. MOTIVE POWER & MACHINERY.

TABULATION OF Combined MOTOR TROUBLES MONTH OF February 1908

	Grove Hall	Forest Hills	Dorchester	Lenox St.	Sewall St.	Jamaica Pl.	Pare St.	Neponset	Milton	E. Boston	North Pt.	Chas. Neck	Salem St.	Everett	Murray St.	Watertown	Mt. Auburn	Cla. Hill	Arlington	North Camb.	River St.	Summer St.	Allston	Oak Sqr.	Reservoir	Total
Shell & Spool		3	4	1	10	20	2	1	3		4	7	6		1	3	8	12	5	2		3	2	1	1	98
Motor Flash					5	10	4		2	1	7	8	9	3		9	3			7					1	69
Armature Grounded	4	8	3	4	5	16	4	1			16	4	7	2	1	3	2	5	5	1	4	2	4	1	1	103
Bands & Coils	2			1			2										2			2						9
Commutator	1				1	7	1	4		1	1	2	3			1		1	1	12						36
Brush	1					3									1											5
Brush Holder	10	1	1	4	1	22	13	1	2	3	12	8	1		3	2	11	10	9	8	3	1		4	1	123
Leads	5	8			3	7	4	2	1	6	6	3	9	1	9	3	6	7	3	6		1	1		4	89
Fuses																										6
Bearings			1									1	2		1	1	1	1								4
Pinion											1							1								2
Shaft		1				1						2	1					1		1						7
Gear												1	1			1										3
" Case											2															2
Cap Bolt																										
Total	23	21	9	10	25	86	30	9	8	11	44	34	40	7	10	23	33	39	23	31	7	7	6	7	555	
Defects per motor	.5	.583	.346	.909	.862	.344	1.18	.880	.278	.262	1.	1.13	.847	.420	.6	1.04	1.50	1.69	.852	1.09	.520	.667	.412	.184	.202	.840
Total motor mileage					6,623	444																				
Total																										
No. Motors in Service																										
Defects per Motor																										

FIG. 6.—TABULATION OF COMBINED MOTOR TROUBLES

During February truck troubles on the entire system aggregated 66, and major and minor brake troubles 125. Of the brake troubles 92 were from faulty adjustment, indicating a line of improvement to be followed in the detail work of the car house foremen. Even though this trouble was the most frequent, it was practically confined to about half a dozen houses, and this localizing of defects is one of the chief advantages of the system. The weak spot is not concealed. The cause may be perfectly legitimate in the case of a car house which far exceeds the rest on the system in the frequency of a certain fault, but if it is justifiable it is essential to know the fact. Any car house putting into service a new type of air-brake equipment or making an extensive discard of the hand brake, except as a reserve, can be watched with the advantage which always attends the use of figures as compared with qualitative experience. While the 92 cases of trouble due to adjustment are the chief interest, the preponderance of any defect like trouble with rubbers or compressor armatures would be a possible subject of inquiry in working out the system's suggestiveness.

Another card of considerable interest on a large road is that which records the totals by car houses of troubles reported and nothing found. During February on the Boston system these aggregated 134, as follows: Car bodies, 8; motors, 18; control, 8; trucks, none; brakes, 15; air brakes, 2; fuse blown, 54; other causes, 29. The general tendencies of this record from month to month are to throw light upon the work of both the car service men and the car house inspectors. In the past three years the company has made special effort to reduce these false alarms of equipment failures, and from a maximum of 447 in March, 1905, the record was brought down to 126 in January, 1908. The need of cutting down such reports is apparent when viewed from the standpoint of car service and the cost of inspection and repairs. If a motorman is not thoroughly assured that his car is suffering from a definite defect, and reports it as defective on the slightest provocation, perhaps to get another car to operate, the cost of inspection is raised unreasonably. On the other hand, if an inspector does not find a trouble that actually exists when it is reported, the future failure of the car on the street or its subsequent repairing at heavier expense are a cause of a larger operating cost than would be the case with closer cooperation and more skilful diagnosis of troubles. In this tabulation from month to month the weak spots in the personal knowledge of the car service men tend to become

BOSTON ELEVATED RAILWAY CO. DEPT. MOTIVE POWER AND MACHINERY

Form 1120-6-06 RECORD OF WP 50 ARMATURE NO. 14178

Car House	Received	Put in Service	Car No.	Type of Car	Removed	Mileage	CAUSE OF REMOVAL: COILS Ground	COILS Short Circuit	COILS Open Circuit	COMMUTATOR Worn	COMMUTATOR Out of Round	COMMUTATOR Short Circuit	COMMUTATOR Rough	COMMUTATOR Flat	SHAFT Sprung	SHAFT Cut	PINION Worn	PINION Loose Sleeve	PINION Loose	PINION Worn Out	Leads	Short Circ.	Broken	Blowing	Fuses	Flashing	REMARKS
F. Hills	12/10/06	12/24/06	274	2-1 60 A	2/1/07	7,998		X																			
Shop	2/6/07				2/6/07							TC								✓							
North Point	2/7/07	4/7/07	809	2-1 60 X	2/26/07	1325	X																				
Shop	3/1/07				3/7/07			✓																			
								7 coil				use															
												Man															
Mt. Auburn	9/7/07	3/12/07	969	2-1 60 X	4/18/07	2993		✓																			
Shop	4/18/07				4/22/07		✓	✓									✓										
Lenox St.	4/22/07	4/24/07	2 cars		1/24/08	9451	✓																				
Shop	1/24/08																										

FIG. 7.—ARMATURE RECORD

clear, and the points to lay stress upon in talks with the platform men by inspectors and foremen are in some measure suggested by the equipment parts most commonly reported as in trouble.

From the standpoint of maintenance no part of the car equipment is of as much importance as the motors. To enable the company to watch the performance of new and older motor equipments with critical scrutiny, several card records have been devised.. The first card, which, like all the others described, is of the standard 5 in. x 8 in. size, shows all of the troubles occurring with each type of motor each day at each car house; that is, a seperate card is used for each type of motor at each car house. These cards, like that shown in Fig. 4, are ruled vertically to give 31 columns, one for each day of the month. The second card tabulates the records of troubles at all the car houses for each type of motor. A third card, which corresponds to that shown in Fig. 5, except that it relates to motors instead of car bodies, gives in the aggregate the troubles for all the motors. Fig. 6 is a reproduction of this card for February, 1908. The total, 555, is considerably less than that shown for December, 1905, or 1518.

On this card also a record is made of the motor defects per 10,000 motor miles. While the average for the entire surface system in the month of February was 0.840, that of individual car houses varied from 0.164 to 3.44. This is a range of 1 to 20 and emphasizes the advantage of figures of this kind. It would not, of course, be accurate to judge the performance of different car houses by these unit figures without knowing the conditions under which they are operating. The introduction of a number of new and untried motors or the use of a very old type on a given division might temporarily result in a large number of failures per 10,000 motor miles.

Each motor armature is also provided with a record card that goes with the armature wherever it is sent for change or repairs. The card gives a brief history of all changes, mileage, repairs and faults that occur in the life of the armature. It becomes more valuable as the armature grows older. If the armature goes into the armature shop, the card accompanies it, and when the armature goes back to a car house it still carries the card. One of these cards is shown in Fig. 7. A card used in the tabulation of all armature repairs on a monthly basis as made in the armature room at the Albany Street shops is shown in Fig. 8. Space is provided for the recording of all defects on each type of motor, and on the reverse side (Fig. 9) of all general and special repair work done by the armature department.

Table I shows the combined motor defects of each kind since the record system was placed in operation in November, 1905. The general trend of diminishing troubles is evident in practically every item. Motor flashes have been gradually brought down from 213 in November, 1905, hard problem, first increasing and then decreasing to a present figure of 103, against 198 in 1905. Bands and coils have fallen from 29 to 9; commutators from 207 to 36; brush holders from 378 to 123; leads from 138 to 89 and bearings from 24 to 5. The defects per 10,000 motor miles for the entire surface system have decreased from 1.98 to 0.84, or a reduction of 57.5 per cent. The progress was not continuous, but its general trend is toward economy, and the items have been reduced by the definite records applied month after month in the overcoming of trouble.

Table II shows the comparison of surface car defects per day in the period through which the system has been applied. The average per day has decreased from 136.6 to 58.7. Every item has decreased. Car body defects per day have fallen from 31.6 to 19; motors from 50.6 to 19.1; control from 30.93 to 9.4; trucks from 6.2 to 2.3; brakes from 12.46 to 4.3, and troubles reported, but nothing found, from 5.26 to 1.8.

In addition to the tabular statistics mentioned a card record is also kept for each car. Five cards of standard size are used. The guide card which is marked with the car number provides for a record of all major repairs made to the car body. The second card is used for recording all truck occurrences. The third card is for the air brakes, the fourth for the control, and the fifth for the motors. All repairs, defects, accidents and work done

WORK PERFORMED IN ARMATURE ROOM C. P. S. DURING MONTH OF 190

MOTORS	W. P. 50	G. E. 800	G. E. 68	G. E. 70	G. E. 74	W. 12	W. 12 A.	W. 68	TOTAL
Armature Coils Made									
Field Coils or Spools Made									
Commutators Made									
Slot Insulations Made									
Mica Rings Made									
Brush Holder Insulators Made									
Armature Shafts Fitted with Sleeves									
Armature Shafts Fitted									
Total Armatures Rewound									
Total Armatures Repaired									
Total Field Spools Repaired									

GENERAL WORK

Rheostat Spark Coils Rewound	Christensen No. 2 Comp. Armature Coils Made
P. M. Armatures Rewound	Christensen No. 2 Comp. Spools Made
M. M. Switch Coils Wound	Christensen No. 2 Commutators Made
Controller Magnets Made	Resistance Box Bolt Insulators Made
Controller Magnets Repaired	
P. M. Field Coils Rewound	
P. M. Brake Coils Rewound	
Governor Coils Rewound	
Reverser Coils Rewound	
Reverser Coils (G. E.) Rewound	
Junction Boxes Insulated	
Junction Box Covers Insulated	
Mica Prepared for Rheostats lbs.	
Iron Assorted and Insulated for Rheostats lbs.	
B. E. Lamp Coils Rewound	
A. B. Lamp Coils Rewound	
Cheatham Resistance Coils (N.S.) Rewound	
Cheatham Circuit Changing Coils Rewound	
Cheatham Switch Coils Rewound	
Cheatham Tripping Coils Rewound	
Series Relay Coils Rewound	
H 20 Journal Box Wipers Sewed	

FIG. 8.—FRONT OF ARMATURE ROOM'S MONTHLY REPORT

Form 993 2M-10-05 **BOSTON ELEVATED RAILWAY—Dept. Motive Power and Machinery.**

Tabulation of Defects — Armature Room C. P. S. During Month of_____ 190

MOTORS	MOTOR ARMATURES: Grounded	Winding Shtd. Ckt.	Leads Broken	Band Broken	Coarse Rind Off	Commutator Worn Out	Commutator Grounded	Commutator Sparking	Commutator Bands	Shaft Loose	Shaft Sprung	Shaft Broken	Loose Worm	Loose Pinion	Pinion Worn	Mech. Defects (To Polarity Only)	Total No. Rewound	FIELD SPOOLS: Grounded	Short Circuited	Open Circuited	Leads Broken	Leads Burned Off	Total No. Rebuilt	Total No. Rewound
W. P. 50																								
G. E. 800																								
G. E. 68																								
G. E. 70																								
G. E. 74																								
W. 12																								
W. 12 A																								
W. 68																								
TOTAL																								

FIG. 9.—BACK OF ARMATURE ROOM'S MONTHLY REPORT

TABLE I.—SHOWING COMBINED MOTOR DEFECTS.

	1905	1906												1907												1908	
	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Shell and Spool	81	95	57	87	107	71	88	101	127	109	103	69	55	100	78	119	153	101	105	120	150	114	147	109	99	74	69	98
Motor Flash	213	233	208	193	187	179	169	103	100	133	130	168	140	178	145	128	164	169	173	155	75	89	99	140	140	74	71	69
Armature grounded	198	172	186	162	202	162	192	133	188	203	237	299	350	139	295	264	344	338	303	216	218	224	245	235	177	138	106	103
Bands and Coils	29	17	20	13	27	22	14	15	16	28	9	12	20	20	18	18	15	35	21	27	14	14	11	14	22	20	11	9
Commutators	207	190	175	207	144	95	120	95	91	100	82	94	81	129	101	96	119	154	178	93	65	65	62	61	74	53	56	36
Brushes	....	431	....	....	....	64	42	30	46	55	93	151	119	148	102	52	91	115	84	29	22	24	20	15	1	5	10	5
Brush Holders	378	431	377	318	360	284	295	196	202	280	360	369	347	385	413	339	325	373	413	256	203	200	263	234	145	146	123	123
Leads	138	154	156	172	199	130	140	99	114	89	153	144	147	189	154	158	173	157	160	103	79	69	117	87	68	63	72	89
Bearings	....	24	46	37	38	36	25	29	25	33	47	58	38	26	27	23	52	44	71	28	17	26	24	27	24	18	15	5
Pinion and Shaft	....	....	9	10	14	13	9	7	9	10	8	9	15	15	12	10	16	15	28	11	10	5	7	3	12	8	7	6
Cap Bolt	....	....	....	....	....	....	....	....	....	....	1	4	7	5	5	4	1	5	2	2	1	1	2	....	2	....	....	2
Collar	....	....	....	....	....	....	....	....	....	....	1	1	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Jumper	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Gear	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	7	3	3	8	7	6	12	7
Gear Case	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	6	10	10	10	5	2	5	3
Total defects.*	1518	1328	1247	1206	1293	1069	1105	814	929	1045	1233	1399	1326	1530	1362	1218	1467	1517	1540	1045	867	844	1010	943	735	607	556	555
Defects per 10,000 motor miles	....	....	....	....	....	1.75	1.85	1.59	1.95	2.19	2.43	2.05	1.99	2.25	1.98	1.99	2.11	2.25	2.40	2.06	1.67	1.66	1.87	1.36	1.07	.870	.810	.840

* Including defects recently consolidated under above listing, and omitted in table for that reason.

TABLE II.—COMPARISON OF TROUBLES, SHOWING AVERAGE TOTAL SURFACE CAR DEFECTS PER DAY.

	1905	1906												1907												1908	
	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Car Body	31.16	38.58	33.8	32.9	33.1	27.0	27.3	25.1	22.3	18.9	21.7	37.6	34.4	35.7	37.3	39.1	30.8	26.5	24.1	18.8	12.7	11.3	15.4	16.0	17.4	17.6	19.0	19.0
Motors	50.6	42.83	40.2	43.1	41.7	35.6	35.6	27.1	29.9	33.7	41.1	45.1	40.8	49.3	43.9	43.7	47.2	50.5	49.6	34.8	27.9	27.2	33.6	30.4	24.4	19.5	18.0	19.1
Control	30.93	19.87	16.9	19.3	17.4	16.1	14.4	11.2	11.9	12.3	13.5	15.9	11.8	19.7	13.7	15.7	14.9	13.4	12.1	10.8	8.0	9.1	11.8	9.6	9.6	8.1	7.7	9.4
Trucks	6.2	7.0	4.7	5.67	6.45	2.96	4.64	5.0	5.54	4.90	4.86	5.09	4.8	5.97	5.9	5.5	6.09	4.1	3.8	7.7	2.1	1.4	2.4	2.2	2.4	3.1	2.45	2.3
Brakes	12.46	16.74	14.8	14.0	14.87	5.46	7.32	5.33	5.41	5.93	8.86	9.19	8.8	14.3	11.4	11.1	12.9	11.3	7.8	3.5	2.4	2.8	4.4	3.2	2.7	4.2	3.58	4.3
Fuses Blown	....	....	4.54	5.21	4.87	6.0	5.70	2.93	3.32	3.48	3.33	4.35	4.13	3.19	4.7	3.9	4.2	4.3	5.2	2.9	2.1	1.5	2.2	2.9	2.3	2.3	4.06	4.6
Trouble Rep. Noth'g F'd	5.26	12.32	14.3	13.8	14.4	12.5	11.1	8.03	8.87	8.35	8.63	12.9	11.3	11.0	12.2	7.2	9.8	11.5	10.7	8.1	6.4	4.7	6.3	6.0	5.3	5.0	1.87	1.8
Aver. per day	136.6	134.8	124.9	128.9	128.0	99.7	100.5	81.8	84.0	84.1	98.6	125.8	15.4	138.4	129.1	126.2	122.0	117.5	108.3	78.9	59.8	56.6	74.1	67.6	62.2	58.0	59.8	58.7

on these parts are entered on these cards, which are kept as the car house file.

Still another card record of repairs is kept at the shop. One side of this card gives instructions from the car house foreman to the repair shop foreman at the Bartlett Street shops specifying the nature of the repairs needed, whether on body wiring or foundation brake rigging. After the repairs have been made the card is sent back to the car house with the car. The car is then inspected, and if found satisfactory the card is signed by the car-house foreman as a receipt for the car and sent to the Bartlett Street shops for filing.

TABLE III.—COMPARATIVE STATEMENT OF EQUIPMENT AND DEFECTS.

	FOUR MONTHS ENDING JAN. 31, 1907.			ENDING JAN. 31, 1908.		
Cars in service	No.	Car mileage	Ton miles	No.	Car mileage operated	Ton miles
Mail	10	20,104	160,832	10	20,172	161,376
Service	51	8,300	66,400	57	10,566	84,528
Box	1,556	3,307,275	33,734,205	1,529	3,221,975	32,864,145
Semi-convertibles	75	172,120	4,027,608	138	280.013	6,720,312
Total	1,692	3,507,799	37,989,045	1,731	3,532,726	39,830,361

5% increase in ton mileage.

The above cars were operated with motors as follows:

Box cars 28'-26'6-25'-24'and 20' long.

Avg. age of motors	Mileage
14 years. 2 W P. 50	1,255,342
11 " .2 G.E. 800	555,591
10 " .2 West. 12 or 12 a	581,578
6 " .2 West. 68	40,257
6 " .2 G.E. 58	704,206
3 " .2 G.E. 70 / .4 G.E. 70	198,705

Semi-convertible Cars

New .2 G.E. 73	71,842
1 year. .2 G.E. 74	100,278
New .4 G.E. 202	
" .2 W.H. 121	
Total car mileage	3,507,799

The above cars are operated with motors as follows:

Box cars 28'-26'6-25'-24 and 20' long.

Avg. age of motors	Mileage
15 years. 2 W. P. 50	660,027
12 " .2 G.E. 800	421,293
11 " .2 West. 12 or 12a	405,750
7 " .2 West. 68	37,983
6 " .2 G.E. 58 (old)	633,786
3 " .2 G.E. 70 / .4 G.E. 70	195,448
¼ " .2 G.E. 58 (new)	898,426

Semi-convertible Cars

1 year. .2 G.E. 73	112,522
2 years. .2 G.E. 74	85,696
New .4 G.E. 202	71,265
" .2 W. H. 121	10,530
Total car mileage	3,532,726

TABLE IV.—DEFECTIVE CARS REMOVED FROM SERVICE.

FOUR MONTHS ENDING JAN. 31, 1907, COMPARED WITH FOUR MONTHS ENDING JAN. 31, 1908.

	NUMBER OF DEFECTS.					NUMBER OF DEFECTS.				
CAUSE	Oct. 1906	Nov. 1906	Dec. 1906	Jan. 1907	Total 4 months	Oct. 1907	Nov. 1907	Dec. 1907	Jan. 1908	Total 4 months
Car bodies including fenders, fittings, wiring and switches, broken glass	1165	1033	1152	1157	4507	496	522	546	590	2154
Motors	1390	1318	1488	1338	5534	917	718	588	527	2750
Semi-convertible: Car motors	9	8	42	24	83	26	17	19	29	91
Trucks and brakes	442	408	614	541	2005	173	161	240	187	761
Control	495	356	471	426	1748	298	290	252	239	1079
Total	3501	3123	3767	3486	13,877	1910	1708	1645	1572	6835
Aver. defects per day	113	104	121	112	113	62	57	53	51	56
% of defects to cars in operation	7	6.2	7.2	7	7	3.6	3.4	3.	3.	3.2

SUMMARY.

Average decrease in defects due to new equipment (estimated 15%) 8½ per day
Average decrease in defects due to better work 48½ " "
Total: 57 " "

ESTIMATED ON 4 MONTHS BASIS.

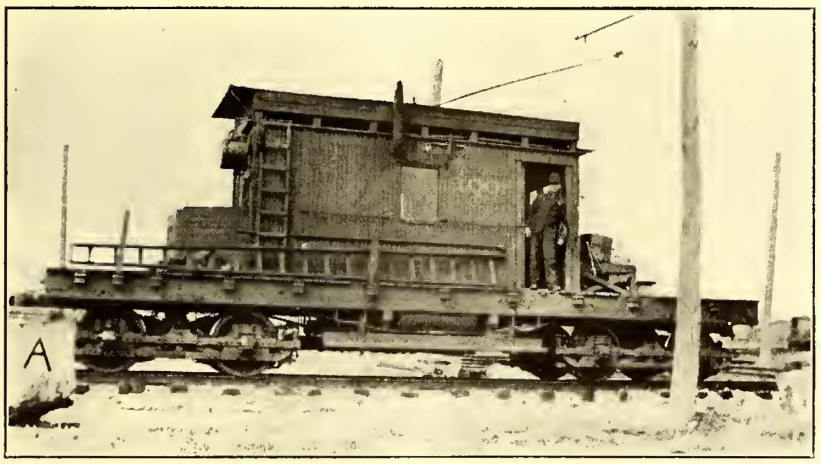
Decrease in car defects due to better work, 4 months' basis 42%
Decrease in maintenance due to better work, Jan., '07, vs. Jan., '08 12%

Table III is a comparative statement of equipment made up in the office of the superintendent of rolling stock and shops as for January, 1907, and January, 1908. Table IV compares the defect record for the four months ending Jan. 31, 1907, with the corresponding period of 1907-08. This table shows an average decrease in defects per day due to new equipment as 8.5, and to better work, inspection, repairs, etc., 48.5.

MAINTENANCE OF OVERHEAD LINE ON THE WESTERN OHIO RAILWAY

The Western Ohio Railway Company operates 112 miles of interurban road from Findlay, Ohio, south through Lima to Piqua, with branches from Wapakoneta to Celina and Minster. The power station is at St. Mary's on the Celina branch. All of the trolley and transmission lines on the system are maintained by one line crew and car, which has headquarters at the company's repair shops at Wapakoneta. The accompanying illustration shows the type of line car used.

The car was remodeled from a motor flatcar. It is 30 ft. long and in the center a cab or house was built about 10 ft. long, 6 ft. wide and 8 ft. high. There are doors in each side and windows in each end to give the motorman a clear view of the track in either direction. The motor controller, brake valve and other accessory apparatus are mounted in the center of the cab with a seat for the motorman built against one wall. A stove is used for heating and for cooking meals when the crew is detained out on the road. Around the walls are bins and racks for holding small repair parts of every description required in line construction and for linemen's tools.



LINE REPAIR CAR USED ON THE WESTERN OHIO RAILWAY

The open platform at one end of the car is used for storing reels of wire, cross-arms, jacks, wrecking frogs and other heavy material. The other end of the car is used for loading any emergency material required which is not usually carried on the car. Two 12-ft. wooden ladders are carried in suitable brackets on the side of the cabin and all the necessary pole-setting tools are stowed between the roof of the cabin and the working platform above.

A heavy platform is built over the roof of the cabin and is surrounded with a gunwale 6 in. high which prevents tools which the men are using from rolling off to the ground. This platform serves as a place to work on when making all trolley and bracket repairs. A 2-in. x 3-in. wooden coping is carried around the top of the gunwale projecting toward the inside. This provides a convenient means of reaching the pole line carrying the high-tension wires at one side of the track. A 2-in. x 12-in. plank about 10 ft. long is carried on the car, and when it is desired to work on the pole line at one side of the track, one end of this plank is inserted under the coping around the platform and the plank allowed to rest about midway on the top of the coping on the side next to the pole. When repairs are completed the plank can be quickly withdrawn and the car moved at once.

The line crew consists of a motorman, who has entire charge of the movement of the car over the line and who is never called on to do any repair work; a line foreman and a helper or ground man. In the spring and summer, when line maintenance is heavy, an additional helper is employed. These men live near the shops where the car is stored, and are subject to call at any hour for emergency work. Their nominal day's work is nine hours. When not engaged in emergency repair work, the car is sent out over the line for inspection and regular maintenance. When making an inspection one of the line crew inspects from the front end and the other from the rear end as the car moves over the road at a speed of about 15 miles an hour. If any broken or defective insulators, hangers, brackets, cross-arms or other parts are defective, the car is stopped and the defect repaired. Except when employed in cases of extraordinary emergency repair work the car and crew go over the entire line about once a week, making regular inspections.

The line car has the rights of an extra train and runs from point to point by train order received from the dispatcher the same as any other car on the road. A train schedule is mounted in a frame over the controller in plain view of the motorman and he is supposed to get in the clear at the nearest siding ahead of all regular passenger trains, except, of course, when the crew is at work repairing damages which prevent the operation of the car. The car is fitted with a portable telephone set and the motorman in charge is required to report his whereabouts at intervals of about an hour and to receive instructions from the dispatcher to move to any other point on the system where the car is required immediately. The Western Ohio has permanent telephones located in reporting booths at sidings and it is not equipped with jacks at frequent intervals as are many of the interurban roads in the Middle West, nor do the regular passenger cars carry portable telephone sets. When the repair car is not at a siding at the regular reporting time one of the line crew climbs the nearest pole and cuts in the portable set carried on the car on the dispatcher's telephone line. The line car is equipped with four motors and is geared for high speed, so that comparatively little time is lost in making sidings ahead of trains or in getting from point to point on the system. The crew frequently remain at work until an approaching car is in sight before starting for the nearest siding.

For night inspection and work the car is equipped with two headlights, one at each end, which can be turned on the trolley or high-tension line, and this enables the crew to inspect for serious trouble as well at night as in the day time. On each side of the car, inside and outside, are mounted pilot lamps which are kept burning all the time. In case of failure of the high-tension line or interruption at the substations supplying the section in which the car is

working, these lamps indicate the trouble immediately to the crew and they get into communication with the dispatcher's office as quickly as possible in order to locate the cause of the trouble.

The high-tension lines along the right of way and also the few cut-off lines running cross country are regularly inspected at intervals of two or three weeks, except during the winter, by a patrolman on foot, who is furnished with high-power field glasses to inspect the cross-arms and insulators. Ordinarily repairs to the high-tension line are made at night unless the defect is such as to cause an interruption of the service, when the repairs are made at once.

Trainmen are instructed to report to the dispatcher any broken hangers or brackets or other defects in the trolley. In case the line car is working at some distance from the point where the defect has been discovered, one of the crew is sent to the point of trouble on the first regular passenger car. He carries with him the necessary repair parts and tools and makes temporary repairs from the roof of the car on which he has come.

The maintenance of the overhead lines is in charge of the electrical engineer, Mr. Baxter, to whom this paper is indebted for the information in this article.

MEETING OF COMMITTEE ON MAINTENANCE OF WAY, AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION

The first meeting of the year of the committee on economical maintenance of the American Street & Interurban Railway Engineering Association was held at the Hollenden Hotel, Cleveland, Ohio, on Friday, March 27. A number of subjects pertaining to the work of the committee were taken up and discussed. In order properly to begin the work, the subjects suggested were subdivided and each subdivision will be treated separately. The members will receive copies of the subjects to be treated with the subdivisions suggested, and each will write out his ideas and opinions and submit them for consideration at a meeting to be held later on when a report will be formulated from the matter thus furnished.

The meeting was very informal. Those present were: Fred H. Lincoln, assistant general manager of the Philadelphia Rapid Transit Company, chairman; Fred Heckler, master mechanic of the Lake Shore Electric Railway Company, Fremont, Ohio; W. H. Collins, general superintendent of the Fonda, Johnstown & Gloversville Railroad, Gloversville, N. Y.; John Lindall, superintendent of rolling stock and shops of the Boston Elevated Railway Company, Boston; Terrence Scullen, master mechanic of the Cleveland Electric Railway Company, Cleveland, and Sylvester Potter, master mechanic of the Detroit United Railway Company, Detroit.

In the afternoon the members visited the shops of the Cleveland Electric Railway Company. On Saturday the members of the company were the guests of Mr. Heckler, who took them over the Lake Shore Electric Railway to Fremont and Toledo and acted as guide during an inspection of the shops and power houses.

March 25 was an auspicious occasion in the history of the Washington, Baltimore & Annapolis Electric Railway, for it marked the running of the first electric car under its own power from Baltimore to the National Capital. The car also went to Annapolis.

CENTRAL ELECTRIC RAILWAY ASSOCIATION MEETING

The regular bi-monthly meeting of the Central Electric Railway Association was held at the Claypool Hotel, Indianapolis, Ind., March 26. On the day previous, the joint committee of the Central Electric Railway Association and the Central Electric Traffic Association, held a meeting and discussed plans for effecting a permanent organization of the Central Electric Traffic Association. W. S. Whitney presented the following report of this meeting at the opening of the regular meeting Thursday morning.

After listening to various applications made in person, it was the unanimous opinion of the committee that A. L. Neeramer was the most competent of the various applicants for the position of chairman of the Central Electric Traffic Association and secretary of the C. E. R. A. It was determined further that the amount of $7,000 would be necessary to defray the expenses of salary, traveling expenses, office expenses, etc., for the year 1908, and that each road within the territory covered by the association should be taxed pro rata according to their mileage, with a minimum of $2.50 per month. Statements covering this expense will be forwarded to the various roads which are members each month, the same to be paid in advance.

The report was adopted by the association, and the appointment of A. L. Neeramer, as chairman of the Central Electric Traffic Association and permanent secretary of the Central Electric Railway Association, was confirmed.

The president, F. D. Carpenter, called the attention of the association to the work of the committee of Indiana members who have been co-operating with the Indiana Railroad Commission in formulating a revised book of train rules. He suggested that the rules formulated by this committee be adopted as the revised code of the Central Electric Railway Association inasmuch as the committee's rules were substantially the same as the Standard Association rules now in effect. He suggested the advisability of appointing a committee of Ohio members to take up with the Ohio Railroad Commission the adoption of these same rules so that the practice would be uniform in both States.

H. A. Nicholl, one of the members of the Indiana committee, said that if any action was to be taken by the Ohio members, it should be prompt, as the Indiana rules were to be published as soon as they could be approved and printed.

Mr. Shayne, chief inspector of the Indiana Railroad Commission, was invited to address the association, and in a short talk he dwelt upon the attitude of the commission toward the regulation of electric railways. The commission was not now, and did not propose to attempt to issue orders or restrictions which would appear to be an attempt to tell the electric railways how they should be operated. The commission's one idea was to insure such safeguards in the matter of appliances and methods as would make the operation of both the steam and electric railroads in the State safe and comfortable for the passengers which they carry. With regard to the proposed code of train rules, the commission will not take the stand of adopting them, but will merely give them its approval. It will not be obligatory for the railroads to use them, but the commission hopes that they will be adopted uniformly throughout the State, so that trainmen from one road can operate over any other road with a full understanding of the rules and regulations in force. On motion of a member, the following committee was appointed to take up the

matter of uniform rules with the Ohio Commission: F. J. J. Sloat, C. N. Wilcoxen and F. W. Coen.

At the suggestion of C. D. Emmons the following committee was appointed by the president to investigate the present status of the Central Association mileage book, with a view to revising the restrictions placed upon its use or abolishing it altogether: F. D. Norviel, Indiana Union Traction Company; W. S. Whitney, Ohio Electric Railway Company, and F. W. Brown, Michigan United Railways.

E. C. Carpenter, claim agent, Indiana Union Traction Company, asked the association to consider the establishment of an index bureau for gathering, filing and exchanging information with regard to accident claims. He explained the advantages of the system as it has been established in the vicinity of Boston, New York, Philadelphia and Chicago. The following committee was appointed to report on the feasibility of such a plan: E. C. Carpenter, Indiana Union Traction Company; W. G. Robinson, Ohio Electric Railway; F. R. Fahlshing, Ft. Wayne & Wabash Valley; Chas. A. Floyd, Grand Rapids, Holland & Chicago Railway; A. L. Neeramer, chairman of the Electric Traffic Association.

W. Shroyer, auditor of the Indiana Union Traction Company, presented a resolution asking for an extension of time to April 30 for sending replies to Circular 20 of the Interstate Commerce Commission, with criticisms of the proposed standard classification of accounts. The resolution was adopted unanimously by the association.

The following papers were presented: "Standardization of Trolley Wheel, Harp and Pole," by Adam Cole, Vaile & Kimes Company; "1200-Volt D. C. System of the Indianapolis & Louisville Traction Company," by H. V. Murdock, master mechanic of the Indianapolis & Louisville Traction Company; "Electric Motor and Trailer Trucks," by A. C. Vauclain, Baldwin Locomotive Works; "The Future Problems of Electric Railways," by W. M. Dippe.

Abstracts of some of these papers will be found below with the discussion thereon. The next meeting of the association will be held on the fourth Thursday in May. The place has not yet been selected.

1200-VOLT D. C. SYSTEM OF THE INDIANAPOLIS & LOUISVILLE TRACTION COMPANY

By H. D. MURDOCK, Master Mechanic of the Company.

Mr. Murdock's paper was devoted principally to a description of the electrical apparatus used on the cars and in the power house of this 41-mile line. A full description of the line and its equipment was published in the STREET RAILWAY JOURNAL, Jan. 4, 1908. The main interest in Mr. Murdock's paper attaches therefore to his summary of the operation of the system up to date.

So far no trouble has been caused by the 1200 volts on any of the apparatus or wires carrying this voltage. The commutation of the motors is exceptionally good. The wear of the commutators and brushes is almost imperceptible. As far as the wear of the brushes is concerned the indications are that a set will run a million miles. Since the equipment was placed in operation last October it has run more than 260,000 car-miles, 200,000 on 1200 volts and 60,000 on 600 volts, and has operated equally well on each.

The 1200-volt system as compared with the 600-volt system requires less copper in the feeder system, a less number of power houses or substations, has a greater power carrying capacity in the trolley wheel, and higher power motors. The 600-volt system has the advantage of less cost of car equipment. As compared with the single-phase system, the motors of the 1200-volt d. c. system are more efficient, have more horse-power per unit weight, more commutation, less complication in car control. The single-phase system has the advantage in the feeder system and substation equipment.

STANDARDIZATION OF TROLLEY WHEELS, HARPS AND POLES

By ADAM COLE, Vaile & Kimes Company

As manufacturers of trolley wheels we have spent thousands of dollars in making trials and experiments. In sending out trial wheels, reports came back that our wheels had made mileages running up into the thousands and, again, other reports came back that our wheels had made but a few hundred miles and were not suited for their work. We know that on two systems of railways the condition vary quite materially, but a variation in mileage of from 3000 to 36,000 miles put us to thinking, and we immediately tried to locate the trouble. We found that where the wheels had failed the trouble was wholly due to the harp. It is not the intention to criticise any particular design or make of harp, but to point out certain principles which should be followed in their construction. The spindle should fit as tight as possible in the harp and yet be easily removed. With many designs if the spindle fits tight in the beginning it is but a short time until the spindle, as well as the whole, begins to show wear. This is caused by the constant hammering on the trolley wires. This was the cause of the trouble which we experienced. Our wheels were assembled in a harp with a loose-fitting spindle, and, having a greater conductivity than other makes of wheels, arcing took place and the bearings were of short life. We believe that a good fitting spindle in the harp will increase the life of any wheel. Assembling wheels in harps is an important matter. A hammer should never be used to make a driving fit.

With a little care on the part of the manufacturers poles can be delivered weighing within a few ounces of the specified weight. At present poles of the same length will vary in weight as much as 6 lb. In applying poles to the car the tension in the base is set, say, for 20 lb. When a new pole is applied it may possibly weigh 6 lb. more than the one discarded. The wheel will not stay on the wire, and the wheel is at once condemned when the fault lies in the difference in weight of the pole.

Another matter of importance is insuring a close fit between the harp and pole. Seldom does a harp fit tight on the pole give good contact. Ordinarily the contact is in the rivets that go through the harp and pole and the loss of current is great. This can be remedied by having the end of the pole turned for a length of 3 in. or 4 in. to a standard size. The harp should be bored and reamed 1/64 in. larger. The end of the poles should not be painted, but a grease of some kind should be used to prevent rusting and should be thoroughly cleaned before the harp has been placed on the pole, since grease and oil are non-conductors. By this method almost a perfect contact would be obtained at that point. The additional cost of turning the ends of poles would be small. A hollow spindle lathe could be used with a box tool, and poles could be turned out as

*Abstract of paper presented at meeting of Central Electric Railway Association, March 26.

fast as two men could handle them. The users of the poles could well afford to pay the additional cost.

DISCUSSION ON MR. COLE'S PAPER

G. H. Kelsay (Indiana Union Traction Company) said he had experienced the most difficulty from poor contact in the lubricated bearing between the trolley base and the stand. He had seen grooves cut in the stem as a result of the oil being burned out by the current passing. He had overcome this by applying a flexible bond between the upper and lower parts. Roller bearings are satisfactory at first, but the arcing soon destroys the rollers. A stand of this kind which had come under his observation was found to have the rollers reduced in size nearly one-third after a few months of service. Referring to the loss of voltage between the trolley wheel and the base, it was generally believed that the loss must be great, but tests made recently at Purdue University show it to be trifling. These tests were made by passing the conductor wire around two grooved pulleys of large size and holding the trolley wheel stationary while the pulleys and wire were revolved. Various amounts of current were passed through the wire corresponding to the demand by cars of various weights, and observations were made at a number of speeds.

ELECTRIC MOTOR AND TRAILER TRUCKS*

BY A. C. VAUCLAIN, Baldwin Locomotive Works

The electric motor truck is in itself a locomotive and must be so considered in its design and construction. Purely car truck principles of design will not do. It must not only carry the weight put upon it by the car body and load, but must in addition successfully withstand the various strains produced in it by the weight and torque of the motors, the severity of these strains being influenced by the number of motors per car or per train and their distribution. Heavy cars, great variations of loads, high speeds, high rates of acceleration and retardation, frequency of stops, irregularity of road profile, etc., augment the severity of its requirements.

The design of motor trucks is generally beset with the difficulty of certain restricted dimensions. Limited as to wheel base by existing curves, as to width by gage and clearances of road and as to over-all height and length by car body, etc., the designer must continue to construct within these limits a truck fully equal to its requirements and still have sufficient space left for the installation of motors, gears, etc. With the development of higher speed and heavier and larger cars requiring more powerful motors and heavier trucks, the problems of motor truck designs have grown more difficult.

Experience has shown that a rigid truck with springs properly designed and distributed is better than a so-called elastic truck. Fig. 1 shows an electric motor truck of the M. C. B. equalized type, designed for a maximum center pin load of 28,000 lb., and for Westinghouse 135 B motors inside hung. The wheel base is 78 in. Usually the greatest difficulty with which the designer has to deal when motors are inside hung is a restricted wheel base. For the transoms, bolsters, bolster hangers, motor suspensions and clearances there is only small space after the motors are allowed for and sometimes it becomes necessary to ask the purchaser for permission to increase the wheel base a few inches. Transom and bolster width are important, not the least reason being that the riding qualities of the elliptic springs are impaired by a restricted width. A generous wheel base not only simplifies the problems of design, but helps to keep down maintenance costs through lessened rail distortion and wheel flange wear.

It is important to analyze carefully the smallest existing curve around which a truck is intended to operate before

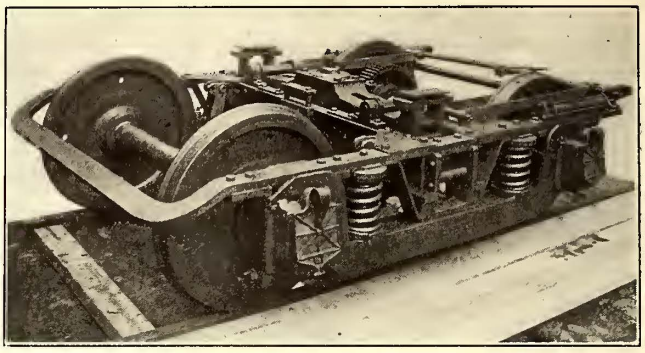


FIG. 1.—M. C. B. EQUALIZED ELECTRIC MOTOR TRUCK FOR PIN LOAD OF 28,000 LB. WHEEL BASE, 78 IN.

determining upon its wheel base. The radius of an existing curve may be found by laying off on the inside rail by means of a tape measure, a chord of any desired length, as shown in Fig. 2.

After the middle ordinate is measured in feet or fractions the following formula can be used:

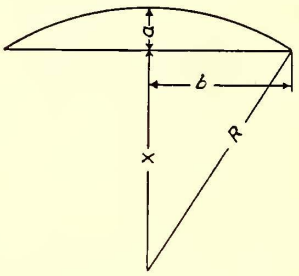


FIG. 2.—DIAGRAM FOR DETERMINING RADIUS OF CURVE

$$R = \frac{a^2 + b^2}{2a}$$

in which

R = radius of curve in feet.

a = middle ordinate in feet.

b = one-half the chord in feet.

Having found the radius of the curve the greatest wheel base which will pass safely around it can be determined by the following formula, assuming M. C. B. standards in flanges and rails, no widening of gage in curve and 31 in. to 40 in. diameter of wheels:

$$W = R \times 0.18$$

in which W = wheel base in inches.

R = radius of curve in inches.

Any spread of gage in the curve will of course increase the permissible wheel base, as will also certain variations of flanges of wheels.

While a sufficient wheel base is desirable, too long a wheel base has its evils also. As will be explained later, the suspension for inside hung motor should be located as near to the center of the truck as possible, and with any given design and size of motor these suspensions must be located farther from the center of the truck for every increase in wheel base. The final determination of the wheel base should, if curves will permit, be based entirely upon the transom width being sufficient to allow a proper width of bolster and bolster springs, and the fixed length of the motors measured from their axle journals to their supporting nose.

The design of a frame depends necessarily upon the conditions to be met. Fig. 3 shows a design of frame for an M. C. B. equalized type of motor truck with inside hung motors. It is based on many years of locomotive experi-

* Abstract of paper presented at meeting of Central Electric Railway Association, March 26.

ence, and is undoubtedly the best design of electric motor truck frame known. The proper distribution of metal can be provided for equally well in both solid and built-up frames, and if properly designed and constructed the built-up frame is as permanent and will stay together as well as the solid frame. It has the added advantage that, built as it is from commercial shapes and sizes of materials, it can be repaired at a minimum cost in shops having only the ordinary repair shop facilities, while a solid frame cannot if seriously damaged by collisions or other accidents. It is, of course, necessary that the workmanship put on it be of the proper quality, but this holds good with the solid frame as well, being a question of machine shop in one case and of smith-shop or foundry in the other. The design of built-up frame which is standard with the Baldwin Locomotive Works is constructed on specially arranged forms insuring accuracy and squareness. All parts are machined where necessary and all holes are drilled to templates, thus providing for interchangeability of like parts or like trucks. All holes are reamed to receive tapered turned bolts having a driving fit, or rivets, as the case may require. Rivets are used only in parts which will probably never require removal and then only when they will be in shear.

The vertical load upon the frame is carried by the side frame trusses between the equalizer springs. No vertical load is carried by portion of frame beyond these springs. The top member is not subject to bending, due to the tractive effort, the bottom members also being in tension or compression with it, and therefore its section can be selected with a view to assisting lateral stability without undue weight. By reason of the journal box flanges and the weight upon the journal boxes, very little deflection of the pedestal legs and consequent twist of the top member of the frame will result in lateral thrusts, which are mostly taken care of by the shearing resistance of the bolts holding the pedestal legs to the frame. Lateral stability is secured by corner gussets between transoms and frames, by the fit of the transom channels riveted to the frame fillings, by end frames which are usually forged solid with the top members of the side frames and by width of section of the

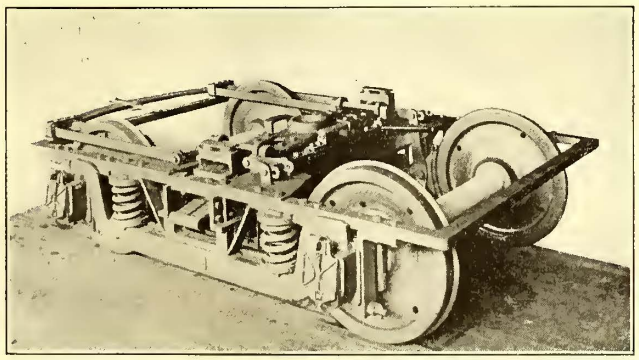


FIG. 3.—EQUALIZED TYPE OF TRUCK FOR INSIDE HUNG MOTORS

top members of the side frames. When forged transoms are used they are lipped over the top members of the side frames and the gussets are omitted, as is also the connection between transoms and frame fillings. If desired the end frame may consist of an angle iron secured to the side frames by means of corner gussets or may be omitted entirely by strengthening the transom channels and gussets. Properly proportioned and constructed it is practically impossible for this frame to get out of square in the hardest kind of service.

For outside hung motors the type of frame is necessarily modified, as shown by Fig. 4. The end frames are of angle iron bolted or riveted to the side frame extensions. The location of motors require the equalizing springs to be placed on the outside of the pedestals to give a longer spring base which necessitates a proportionately greater depth of section in the top members of the side frame, due to the overhang from the trucks. The end braces also become necessary to support the end frames, which carry about 40 per cent of the dead weight of the motor. For trailer trucks the frames usually conform in general design

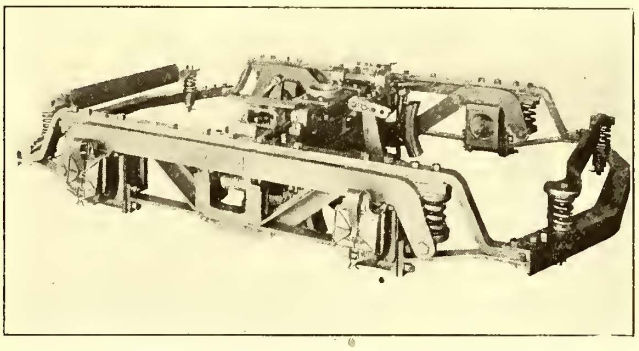


FIG. 4.—TRUCK FRAME FOR OUTSIDE HUNG MOTORS

to those of the motor trucks with which they are to be used.

The chief advantages of equalizers are a shorter truss in the side frame, a slightly added resiliency of the helical springs and diminution of frame height over the journal boxes which could be avoided otherwise only by a multiple nest of helical springs. The transfer of weight from one axle to another is entirely uninfluenced by them. Sometimes these equalizers are fastened rigidly to the journal boxes, but this is not good practice. The object sought is a prevention of spread of wheel base during brake applications, which means a loss of brake piston travel. In the best electric trucks, journal boxes are accurately machined inside and outside, as are also the pedestal legs, and the clearances are small. Therefore, the spread of the wheel base during braking is small. When the journal boxes are rigidly fastened to the equalizers, the faces of the journal boxes are thrown out of alignment with the faces of the pedestal legs and the riding qualities of the truck will be affected.

It is customary to carry about 60 per cent of the dead motor weight upon the axles and the remaining 40 per cent upon the frame. The ordinary types of motor suspension are the nose and bar, supported by the transoms, for inside hung motors and the bar and knee supported by the end frames for outside hung motors. Helical springs are usually interposed between the motor nose and the suspension to minimize shocks of starting and accelerating, relieving the helical truck springs of this particular function.

Upon the location of the motor suspension with regard to the center of the truck or the axle depends the amount of motor weight transferred through the frame from one axle to the other by the torque of the motor and the tendency of the motor to revolve upon the axle when brakes are applied. Let us assume a truck having a wheel base of 6 ft., carrying two motors inside hung, one upon each axle, and weighing 4000 lb., each of which has 60 per cent of its weight carried on the axles and 40 per cent on a suspension supported by the frame at a distance of 1 ft. from the center of the truck. Frequently in starting the torque of the rear inside hung motor will lift its supporting nose free

from the motor suspension. Let us assume that it does so in this case, then 1600 lb. will be transferred from the rear motor suspension to the rear axle, and the like amount will be transferred from the forward axle to the forward motor suspension. The total motor weight upon the frame will remain the same as it was before, but it will be differently distributed and instead of 1600 lb. supported each side of the transom at 1 ft. from the center of the truck we will have 3200 lb. supported from one side of the transom at 1 ft. from the center of the truck and the frame will tilt in consequence.

Let us next assume a truck having a 6-ft. wheel base

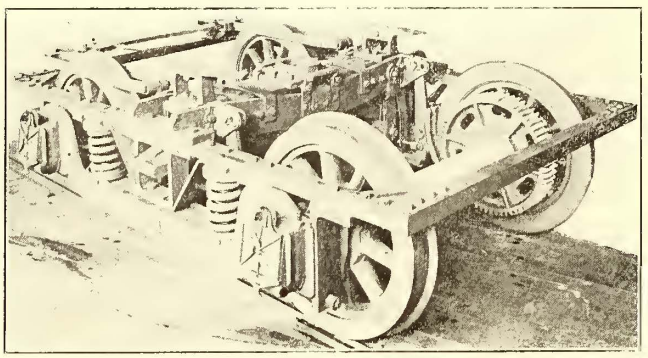


FIG. 5.—TRUCK FOR WESTINGHOUSE NO. 132 MOTORS; CENTER PIN LOAD, 32,000 LB.; WHEEL BASE, 77 IN.

also and carrying the same motors as the previous truck but outside hung, with 40 per cent of the dead motor weight carried by suspension supported on the end frames. In this case the transfer of the motor weight will be from the rear axles to the rear motor suspensions and from the forward motor suspension to the forward axle, and, instead of 1600 lb. of dead motor weight supported at each end of the frame, we will have 3200 lb. supported at the rear end of the frame. As this is supported outside of the spring base of the truck we will have a negative motor weight at the forward end of the spring base and a greater tendency for the frame to tilt than with the inside hung motors.

Tilting the frames throws the pedestal legs out of vertical, and impairs the riding qualities of the truck by reason of the added friction and shocks. Ordinarily, therefore, for inside hung motors, the frame suspensions should be located as near as possible to the center of the truck and for outside hung motors as near to the center of the axle as possible.

In an ordinary two-truck car which is not self-propelled the application of the brakes results in a transfer of weight from the center plate of the rear truck to that of the forward truck, due to the brake pressure being exerted below the center of gravity of the car body and the consequent tendency of the car body to rotate about an axis at the center plate of the forward truck. In the same way the brake pressure being exerted below the center of gravity of the truck, each truck tends to rotate about an axis at the point of contact of its forward wheels with the rails. The rear wheels of the rear truck then will carry less weight during the braking than any of the other wheels.

In the electric car, with motors supported partly by the wheels and partly by the truck frames, the dead weight of the motors is an additional factor, affecting the transfer of weight from one axle of the truck to the other. When brakes are applied to the wheels of the truck the motors tend to revolve upon the axles and with inside hung motors part of the weight of the forward motor is moved forward from the motor suspension to the axle and part of the weight of the rear motor is moved forward to the motor suspension increasing the rotative tendency of the truck. With outside hung motors partly supported by the end frames part of the weight of forward motor will be moved backward from the motor suspension to the axle and part of the weight of the rear motor will be moved backward from the axle to the motor suspension, decreasing the rotative tendency of the truck. With inside hung motors, therefore, the shifting of weight from the rear to the forward axles of a motor truck is greater than that which occurs in an ordinary car truck, while with outside hung motors it is less. Wheel base is also a factor in weight transfer between axles during braking, this being less, of course, with a long wheel base than with a short one.

With inside hung brakes the difference in weight upon the two axles of the truck during braking can be partly compensated for. Referring to the rear truck which will be carrying the lighter load the live lever end of the truck is always pulled forward and the live lever hanger links are in compression. By a proper inclination of these hanger links a toggle joint is formed and an increase of brake shoe pressure on the forward wheel results. This cannot be done with outside hung brakes. Outside hung brakes, while more accessible than inside hung brakes, are less desirable. During the braking period the hanger links of inside brakes oppose the tilting tendency of the frame while those of the outside hung brake augment it.

In the case of an ordinary passenger car, not self-propelled, it is customary to use a calculated braking weight of from 90 per cent to 98 per cent of the light weight of the car. For motor-driven cars the energy exerted by the rotation of the armatures is taken into consideration and a much higher percentage is used, sometimes as high as 115 per cent.

Flanged brake shoes were first introduced for the purpose of keeping the flange of the wheel ground down to compensate for the wear of the tread. As the motors of electric trucks usually prevent the use of brake beams, these flanges are retained in electric truck practice as guides for keeping the shoes in line with the wheel. This

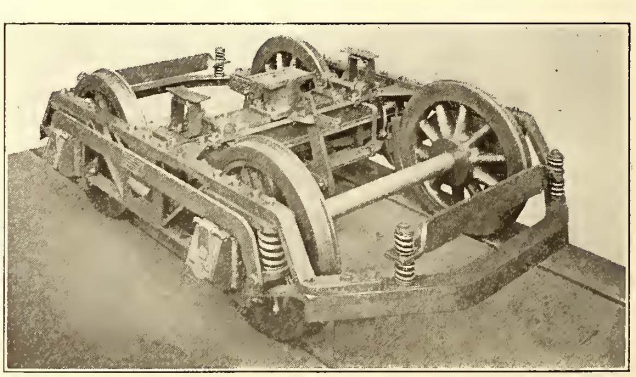


FIG. 6.—TRUCK FOR OUTSIDE HUNG MOTORS; CENTER PIN LOAD, 16,000 LB.; WHEEL BASE, 60 IN.

is no doubt the simplest form of guide that could be devised for this purpose, but used without a brake beam it contributes to the tendency of the brakes to chatter, making more careful manipulation of the brake necessary. Chattering of brakes has given rise to various anti-chattering devices, some of them very good ones, but it would seem better to eliminate the underlying causes rather than to complicate the brake mechanism by additional parts. The Baldwin Locomotive Works are making a careful investigation of this question at the present time.

The side swing of a car can be limited in a variety of ways, but the usual, and perhaps the best, method is by expending the energy in lifting the weight of the car body. Generally, therefore, the truck bolster and the bolster springs are carried upon a spring plank which is suspended from fixed points at the top of the transom by means of swing links, in such a manner that it can move sideways only. Every side movement of this spring plank is attended by a lifting of the car body and the energy is expended in work, thereby limiting the amount of spring. Gravity acting upon the car body brings the spring plank back into place. Inclining the swing links toward the center of the truck increases the height through which the car body is lifted per unit of side swing of the spring plank, thereby decreasing the amount of swing of spring plank. The car body is at the same time thrown out of its vertical and its swing becomes less than that of the spring plank itself.

While chilled cast-iron wheels are still used extensively in electric street railway service, solid steel or steel-tired wheels are now almost universally used upon interurban electric railways upon which the severity of the requirements has reached such a stage that chilled cast-iron wheels may no longer be considered even comparatively safe. The important requisites of a wheel are strength and durability with a minimum of weight, and it is probable that the solid steel wheel will eventually replace the built-up wheel. The steel used in rolled and forged solid wheels is exactly the same as that used for tires of medium hardness, and the method of manufacture seems to increase the density of the material.

Rapid wheel flange wear may result from a variety of causes. A difference in diameter of wheels mounted upon the same axle will cause the flange of the smaller wheel to crowd the rail. When from this cause the flange has become considerably reduced in thickness its further wear may be almost entirely arrested by giving its mate slightly the smaller diameter of the two. A soft wheel reducing its diameter more rapidly than its mate will cause the flange to crowd the rail.

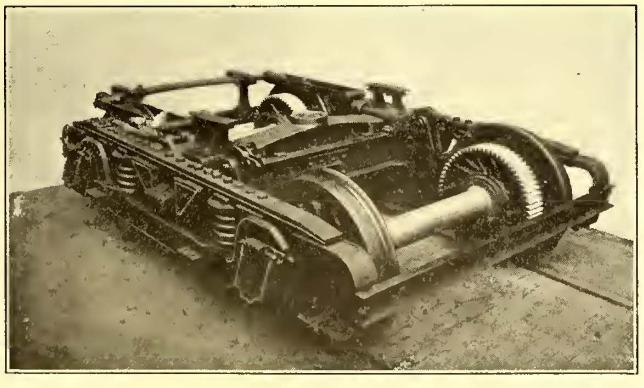


FIG. 7.—TRUCK FOR CENTER PIN LOAD OF 28,000 LB.; WHEEL BASE, 80 IN.

A car operated continually in one direction upon a circular track would wear the flanges of its outer wheels more rapidly than those of the inner wheels due to the centrifugal force of the car; therefore, the character of the road and the direction in which the car is operated influence the flange wear and it will sometimes be found advantageous to reverse the order of the two trucks of a car.

The diametrical wear of the wheel will also be influenced by the character of the road and the direction in which the car is operated. At high speeds on curves the inner wheels of the car may slip, while at low speeds the outer wheels may slide. Brake shoes having unequal coefficients of friction will vary the flange wear directly; also indirectly, through varying the diametrical wear of the wheel tread.

[Mr. Vauclain then presented views of a number of trucks for electric service, including those given herewith. —Eds.]

The truck shown in Fig. 5 was designed for Westinghouse 132 motors, inside hung, and a specified maximum center pin load of 32,000 lb. The wheel base is 77 in., the wheels are 36 in. in diameter and the journals are 5 in. x

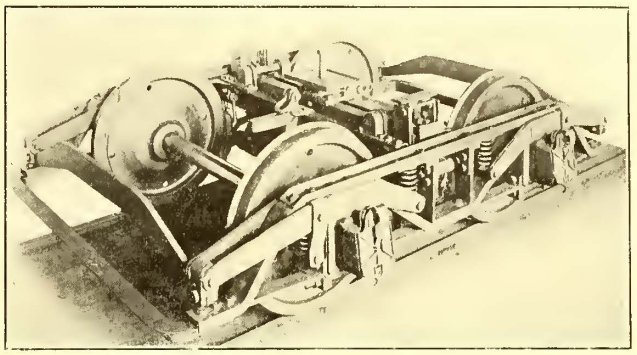


FIG. 8.—NEW DESIGN OF TRUCK FOR OUTSIDE HUNG MOTORS; CENTER PIN LOAD, 17,000 LB.; WHEEL BASE, 54 IN.

9 in. The total weight, exclusive of motors, is 11,000 lb. The transoms are solid forged and are lipped over the tops of the side frames. The end frames are secured by gussets and bolts and rivets. The bolster is built up and the brakes are inside hung.

The truck shown in Fig. 6 was designed for Westinghouse 101-B motors, outside hung, and with a specified maximum center pin load of 16,000 lb. The wheel base is 60 in. and the wheels are 34 in. in diameter. The journals are 3¾ in. x 7 in. The bolster is built up and the brakes are inside hung.

Fig. 7 shows a truck designed for inside-hung motors

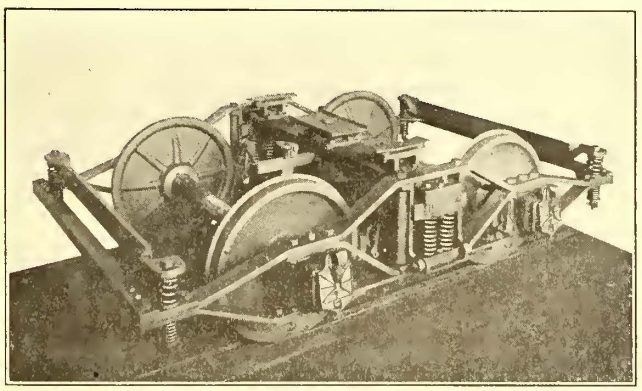


FIG. 9.—ARCH BAR TYPE OF MOTOR FREIGHT TRUCK; CENTER PIN LOAD, 22,000 LB.; WHEEL BASE, 60 IN.

and for a specified maximum center pin load of 28,000 lb. The wheel base is 80 in. The wheels are 34 in. in diameter. The journals are 5 in. x 9 in. Inside-hung brakes are used. The bolster is of cast steel.

The truck illustrated in Fig. 8 was designed for Westinghouse 101-B motors, outside hung, and for a specified maximum center pin load of 17,000 lb. The wheel base is 54 in. The wheels are 33 in. in diameter and the journals are 3¾ in. x 7 in. The total weight of the truck, exclusive of motors, is 6100 lb. The weight of the truck, exclusive

of wheels, axles, brasses and wedges, is approximately only 2600 lb. The method of motor suspension shown is new and has recently been patented by B. R. Van Kirk, mechanical engineer of the truck department of the Baldwin Locomotive Works. The motor weight upon the suspension is fulcrumed over the driving box and is applied to the frame in an upward direction at a point near the center of the truck. In this way it relieves the end frame of the motor weight and decreases the tilting effect of the motor reactions.

Fig. 9 shows an arch bar type of motor freight truck designed for Bullock R-50 motor, outside hung, and with a specified maximum center pin load of 22,000 lb. The wheel base is 60 in. The wheels are 33 in. in diameter and the journals are 4¼ in. x 8 in. The total weight of the truck, exclusive of motors, is 6600 lb.

MAINTENANCE

The maintenance cost of a Baldwin truck should be small, but the old adage, "A stitch in time," etc., holds good with them just as it does with any other machine. The experience of more than three-quarters of a century of locomotive building has been applied to their design and construction. The characteristics of the Baldwin locomotive are combined with the advantages of the M.C.B. running gear. The materials and workmanship conform rigidly to locomotive specification.

The frame properly designed and constructed may be considered as a single piece, subject to no wear except that of the pedestal legs, which will be slow if lubrication is not neglected, as will also that of the journal boxes. When sufficient wear has accumulated between boxes and pedestal legs it can readily be taken up with shims, fastened to the pedestal legs. Adjustable pedestal shoes are unnecessary, but the wear must not be allowed to accumulate too far, as it would result in shocks and in loss of brake piston travel. Wearing plates are provided between bolsters and transoms. These plates are accessible for removal and shimming or renewal to take up wear. The accumulation of too much wear between bolster and chafing plates must be carefully guarded against, not only to avoid shocks, but to prevent damage to the swing links by bedding or by rubbing against transoms. The swing links, shafts and bearings are provided with ample bearing surfaces to minimize wear. All brake pins, levers, links and bottom rod ends are case hardened to resist wear. The circle bar and guide and the pull rods and jaws are but little subject to wear if lubrication is not neglected. Coil springs are so designed that they will set solid before a destructive fiber stress has been reached. Elliptic springs are also so designed when possible.

Lubrication of wearing parts must be looked after. For the center pins a heavy grease should be used, and it is best to raise the car body from the truck to insure getting the grease thoroughly distributed. The top of the center plate collar is a part of the center pin bearing. Heavy oil or grease should be used between pedestal legs and journal boxes, between bolster and chafing plates and between circle bar and its guides.

PAY-AS-YOU-ENTER CARS FOR CLEVELAND

At the shops of the Cleveland Electric Railway Company four pay-as-you-enter cars are being prepared under the direction of M. Scullen, master mechanic. While no decision has been reached as to the use of this class of cars on the local lines, it is probable that they will be placed in service some time in the near future. One of them is almost completed and the others are in different stages of construction. The bodies used are those of 30-ft. cars, which have been in service for some time, and the only change noticeable from the inside is that there are two doors at the rear end instead of one and a swinging door at the front end replaces the old slide style. Eight-foot extensions have been built to these cars, both front and rear. The short sills at the sides of the car have been replaced by continuous steel plate sills 10 in. x ¾ in. in dimensions on the outside of the ordinary wood sills usually used in such cars. The inside sills are of the built-up pattern with a drop of 10 in. in both the front and rear to provide for the drop in the platform.

An enclosed cab for the motorman is provided on the front platform with a door opening about midway in the partition. A short rail extends out from the front of the wall just beyond the door, back of which space is left for smokers. The swing door at this end of the car opens back against this rail. A rolling door is used as the front exit and may be opened or closed by a lever in the motorman's cab. This door is connected with the step, so that when the door is closed the step is turned up out of the way and securely locked.

The rear platform is divided into two sections by a rail in the usual way.

BOSTON NIGHT SCHEDULE CHART

The Boston Elevated Railway Company has published a diagram giving the starting time of night cars from both the in-town and suburban termini according to the schedule now in force. The diagram is presented herewith to show

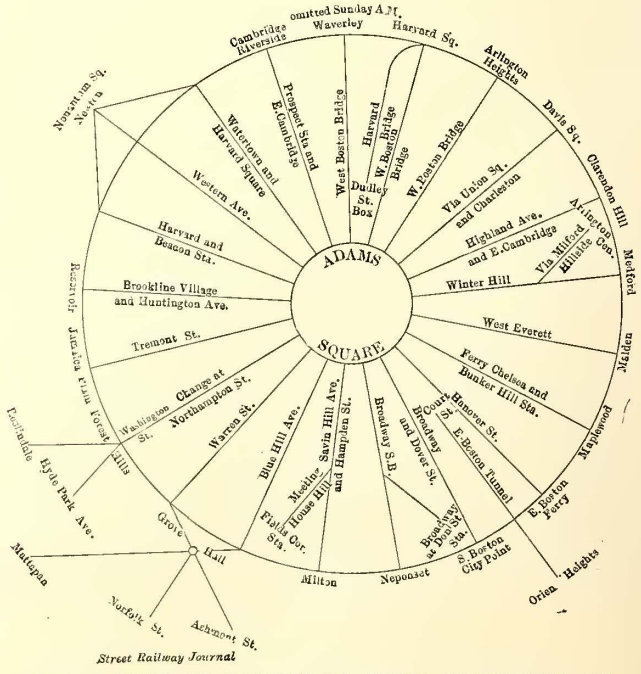


CHART USED IN BOSTON TO SHOW SCHEDULES OF NIGHT CARS

the general arrangement, but the time schedules for the different lines have been left out. Wherever Adams Square is the starting point the outgoing time on the different lines is given at the center of the circle, while the time for incoming cars with the same destination is given at the periphery of the circle with the hour and the minutes. The same general scheme was followed in the cases of such outlying lines as Norfolk Street, Ashmont Street, etc.

THE OPEN TANK TREATMENT FOR PRESERVING TIES AND CROSS-ARMS

One of the serious drawbacks inherent in most methods of wood preservation is the necessity for an elaborate and expensive plant requiring cylinders, vacuum pumps, etc. According to the price quoted recently to a large street railway company in New England, the minimum price for a plant of this kind was $30,000, this plant being adapted for the treatment of ties only. In constructing a new and long interurban line, on which thousands of ties and cross-arms for the right of way are required, it might pay to invest in a treating outfit of this kind, but as most electric railway work is of a maintenance character it means that material is purchased in comparatively small quantities from time to time.

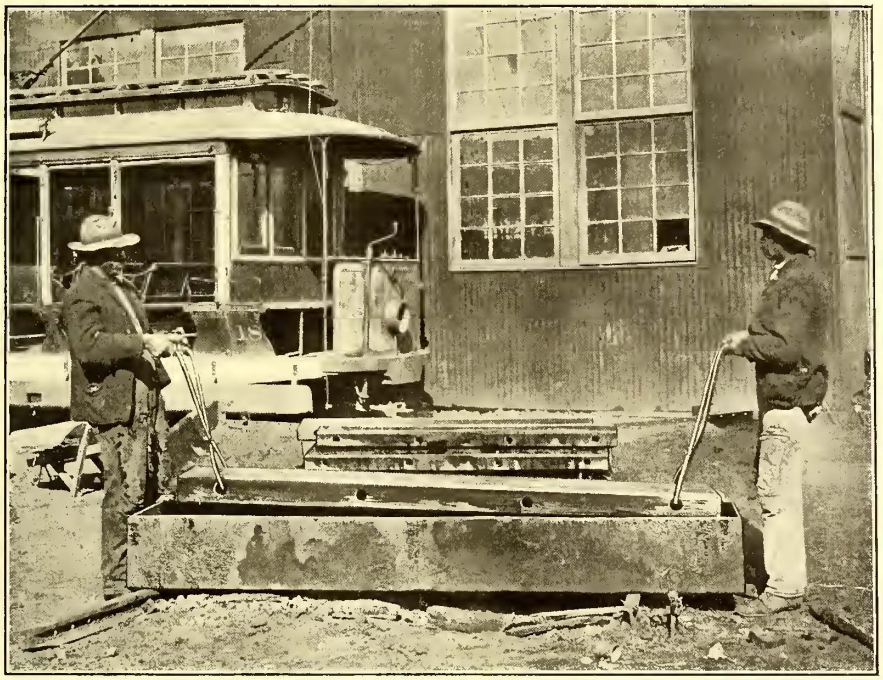


FIG. 1.—USING AN ORDINARY WOOD FIRE TO HEAT THE SATURATION TANK

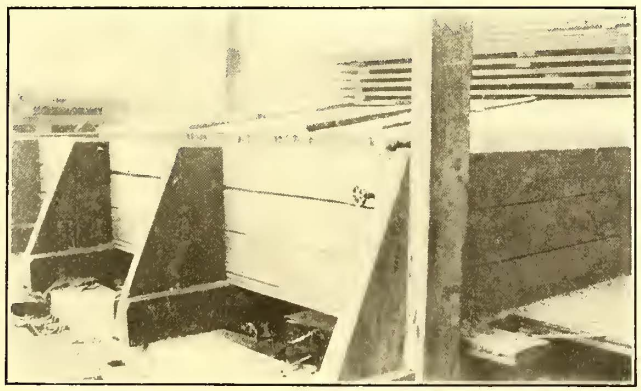


FIG. 2.—STEAM-HEATED SATURATION TANK USED BY THE BALTIMORE & OHIO RAILROAD

One of the heaviest items of expense in the preservation of timber by the vacuum method is the cost of transporting the lumber to and from the plant. Any method which would obviate this expense would be desirable. The treating plant therefore should be easily movable from place to place, of the simplest character and require no skilled labor for its operation. The "open tank method" has been found admirably adapted to these requirements.

About 1833 the first plant using this method was erected. The preservative fluid used was corrosive sublimate. This on account of its poisonous nature was found too dangerous. Later other compounds were used which in their turn were discontinued for various reasons. In the year 1869 Dr. R. Avenarius first produced a wood preservative which he called "Carbolineum." This was a distillate of coal tar, containing a very high percentage of those oils boiling above 600 deg. Fahr., chemically treated and combined with high power antiseptics. It can be applied with a common paint brush or by simply dipping the wood into the liquid.

This material was at first applied at normal temperatures. It was found, however, that by raising the temperature above the boiling point of water partially seasoned wood could be successfully treated, thus opening up a much larger field for the use of the open tank process. This method is applied in various ways by different companies, some immersing the timber in the hot liquid for a limited time, others following the first with a second hot immersion, while still others use a method which is becoming known as the "natural vacuum process," this being treatment for a limited time in the heated oil, followed immediately by an immersion in cold oil.

The simplicity of the open tank

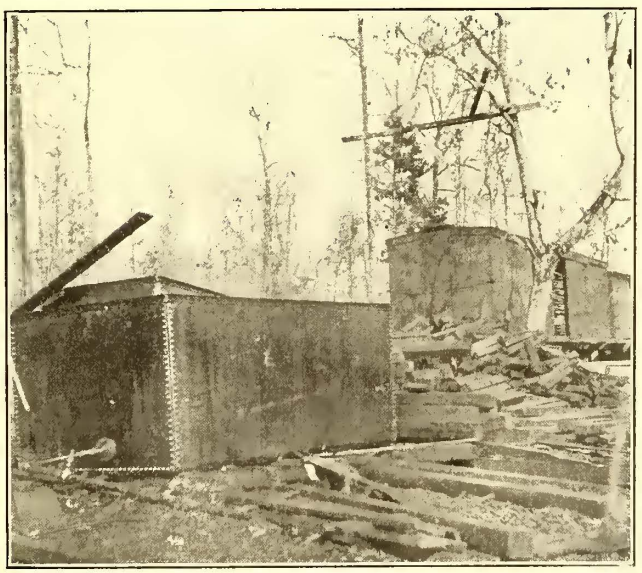


FIG. 3.—DOUBLE TANK USED BY THE SOUTHERN POWER COMPANY. THE OUTSIDE TANK CONTAINS STEAM-HEATED WATER

treatment is shown in the accompanying views of installations made by several railroad and power companies in the Southern States, where considerable attention has been given to this problem. Fig. 1 shows the open tank method as applied by the Columbus (Ga.) Railroad Company in the summer of 1907 for treating some 2000 pine ties for paved track construction. These ties were 6 in. x 8 in. x 7 ft. long. The preservative placed in the iron tank shown was heated by an ordinary wood fire to a temperature just

below the boiling point of water, and the ties immersed in it for about 10 minutes. They are then thrown upon an iron plate placed at an angle dripping toward the tank and are afterward piled to dry out before receiving the second treatment, care being taken in the second dip that the timber is completely submerged and immediately removed. After draining they are stacked ready for use.

simply painted with hot carbolineum, showed very little sign of decay despite their continual exposure to dampness. The ties were found in practically perfect condition. Mr. Reidhead, in referring to the bridge flooring, states that the city of Columbus uses a pine floor on its new iron bridge crossing the Chattahoochee River. The cost of replacing rotting timbers had become so excessive that he recom-

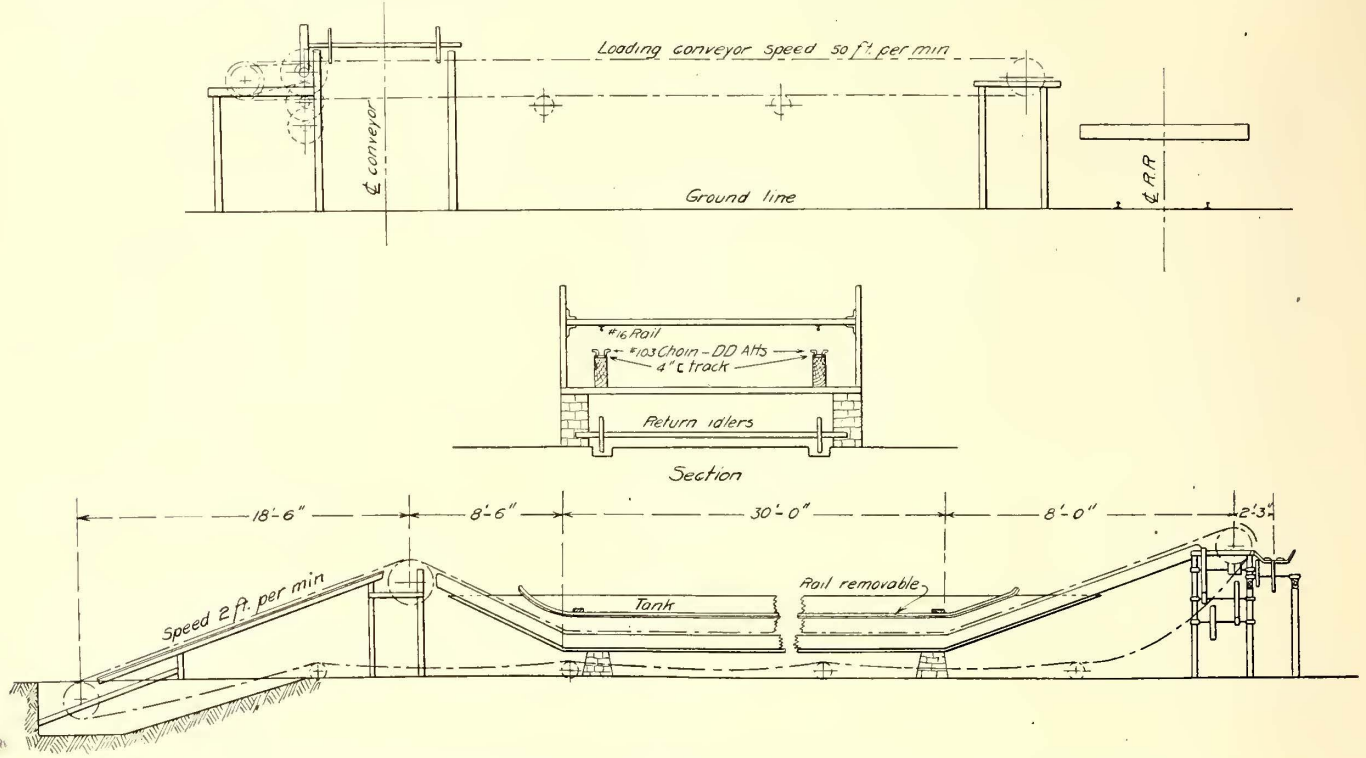


FIG. 4.—CONVEYOR FOR HANDLING TIES USED BY THE NORFOLK & PORTSMOUTH TRACTION COMPANY

The Columbus Railroad Company has also used this tank for treating cross-arms both for its own poles and the high-tension poles of the Columbus Power Company. As this method calls for no more preparation than the wood to build a fire, it can be put in practice in spare hours when

mended this form of treatment to the city engineer. The latter accepted the suggestion and arranged to have the railway company treat a large number of sidewalk planks to be used on the bridge.

Fig. 3 shows the double-tank equipment for treating cross-

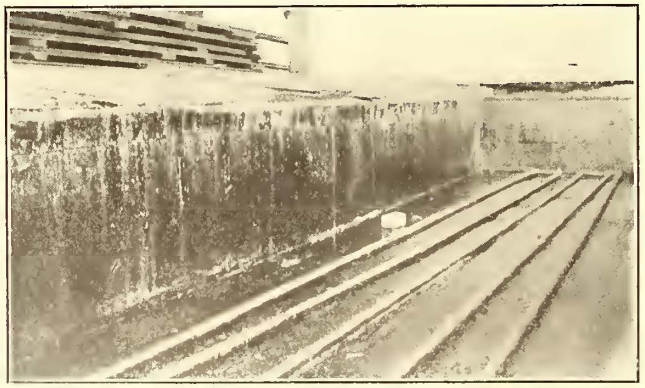


FIG. 5.—INSIDE VIEW OF BALTIMORE & OHIO RAILROAD TANK AT LOCUST POINT PIER, SHOWING STEAM PIPES

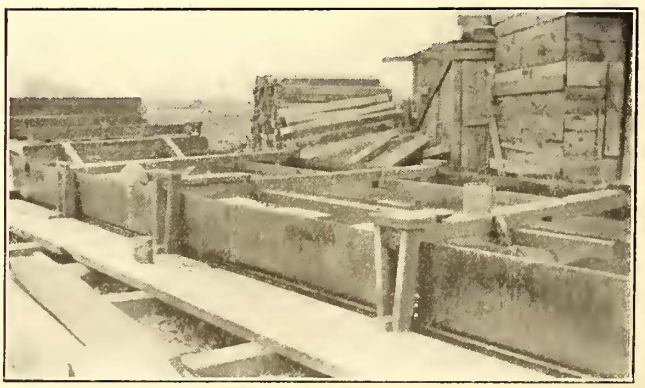


FIG. 6.—TANK WITH CROSS-TIMBERS FOR HOLDING DOWN THE TIES DURING SATURATION

the line or track men are not otherwise engaged, so frequently the actual cost is no more than the cost of the preservative.

The Columbus Railroad Company began the use of avenarius carbolineum about 1891 under J. F. Flournoy, then general manager of the company, who applied it on bridge flooring as well as ties later covered with brick paving. A few months ago F. E. Reidhead, the present manager of this property, took up some of the ties and bridge flooring, which, according to Mr. Flournoy, had been treated nine years before. The bridge timbers, which had been

arms set up by the Southern Power Company, which has about 280 miles of wood pole lines. The inner tank, containing the preservative, is 4 ft. x 8 ft. x 3 ft. deep and is surrounded by a second tank, 5 ft. x 9 ft. x 4 ft. deep, filled with water heated by a steam line from a boiler set up for other purposes. Both tanks are made of 3/16-in. steel plate and stiffened around the top and bottom with 2-in. angles. The treatment consists of a 15-minute immersion in the treating tank while maintaining a temperature of 160 deg. Fahr. in the water in the outer tank. It is customary to put about five barrels, or 250 gal. to 300 gal., in the inner tank

and treat as many cross-arms as the tank will hold at once. A 30-minute immersion test at 160 deg. Fahr. showed that a hard yellow pine cross-arm, 4¾ in. x 5¾ in. x 7 ft., would absorb from 3 lb. to 6 lb. of carbolineum.

It might here be added that the penetration or absorption of the preservative by the wood can be regulated according to the requirements to which the treated lumber will be exposed by varying the duration of the bath and also by varying the temperature.

Figs. 2 and 5 illustrate another variation of the open-tank treatment as applied by the Baltimore Bridge Company for the flooring, sills, braces and other woodwork of the new Baltimore & Ohio Railroad immigration pier at Locust Point, Md. The tank is built of wood lined with sheet iron and is 20 ft. long, 4 ft. wide and 18 in. deep. The preservative liquid is heated to 150 deg. Fahr. by the steam pipes shown at the bottom of the tank. The material is treated for 15 minutes and then allowed to drain on a platform inclined toward the tank before stacking.

The Norfolk & Portsmouth Traction Company used a simple wooden tank for the treatment of ties and bridge timbers. They later purchased a steel tank, as shown in Fig. 5. This tank, which is heated by steam coils in the bottom, is of ¼-in. steel plate, with 2½-in. angle iron corners, is 30 ft. long, 10 ft. wide and 18 in. deep, costing $300 f. o. b. Norfolk. The tank equipped with conveyor chains, as shown in Fig. 4, has a capacity of 1000 ties per day. The cost of these conveyor chains was $450. During 1907 E. S. Ely, the chief engineer of way, treated over 50,000 ties by the open tank process.

At many other places throughout the North and West, notably at Indianapolis and Portland, Ore., the open tank method is used by traction companies. In all of these instances, however, one or the other of the methods here discussed is employed.

"AT WORK AROUND THE WORLD"

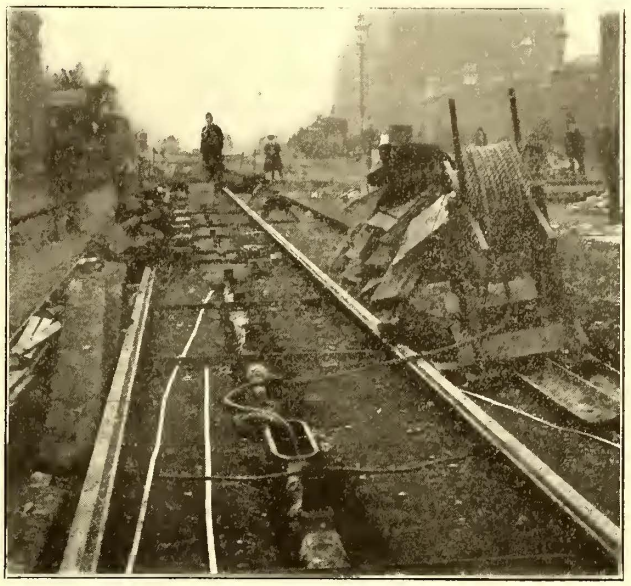
J. G. White & Company, of New York, J. G. White & Company, Ltd., of London, and their associate interests have recently published a very attractive 82-page pamphlet entitled "At Work Around the World." The pamphlet gives illustrations of many of the contracts undertaken by this firm in the United States, Canada, Mexico, the United Kingdom, Holland, India, the Philippines, New Zealand, Australia and many countries in South America. A map of the globe is appended showing the offices' location on the contracts, and other points at which engineering work has been accomplished. A description is also given of each of the important contracts undertaken by the company, which include electric railways, steam railroads, power plants, water power developments, harbor improvements, building construction, etc. A summary of the work now on hand by the companies in the United States, England and Canada shows a total of over $50,000,000.

The State Board of Tax Commissioners on March 31 completed its special franchise tax assessments for this year for New York. The total is $492,492,970, as against $466,855,000 for 1907 and $361,470,300 for 1906.

The companies operating in New York City thus affected are: New York City Railway system, 1908, $87,865,400; 1907, $103,600,000. Brooklyn Rapid Transit system, 1908, $55,437,900; 1907, $54,645,000. Manhattan Railway Company, 1908, $78,500,000; 1907, $74,900,000. Interborough Rapid Transit Company, 1908, $24,012,000; 1907, $24,000,000.

SURFACE CONTACT WORK IN LONDON

The installation of the G. B. surface contact system for the London County Council Tramways from Aldgate eastward by way of Whitechapel and Bow Road to Bow Bridge, a distance of about three miles, presented some interesting problems of construction. In this short line are five



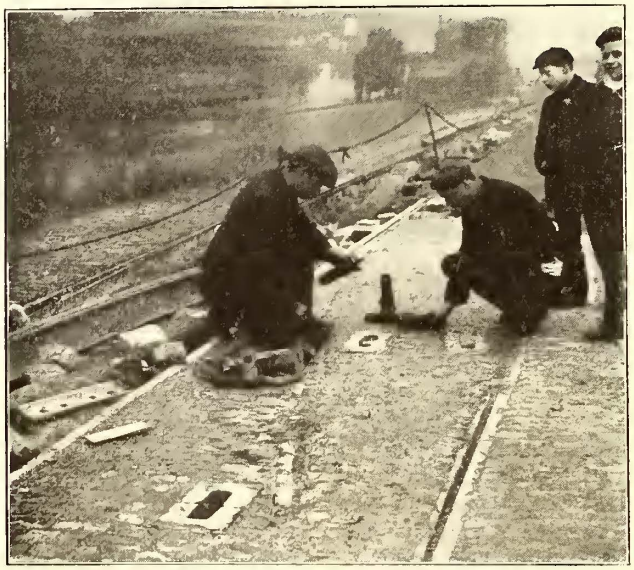
PUTTING IN THE CABLE

cross overs, two acute angle crossings and two double junctions. Altogether 5200 studs have been put down spaced about 6 ft. center to center to suit the London County

BEGINNING THE WORK OF PAVING

Council standard cars, which are equipped with plows for operation over the other routes. This work is now nearing completion, and the line is expected soon to be placed in operation. In general the installation at London does not differ materially from that at Lincoln, England, described in the Street Railway Journal for Feb. 3, 1906. The work has all been done by Dick, Kerr & Company, the well-known contractors of London, at the request of the London County Council. The accompanying photographs show different stages of the progress of the work.

As installed at Lincoln, the lines of which, as before stated, have been closely followed in the London work, current is supplied from a galvanized iron cable carried in a conduit, supported under the center of the track on a corrugated round insulator whose shaft extends through the side of the conduit and is there grounded to prevent any leakage to the contact stud when the latter is supposed to be dead. The connections to the surface studs at London are every 6 ft. instead of every 9 ft. as at Lincoln, for the reason previously given. All longitudinal and vertical joints in the conduit are sealed to prevent the entrance of water. The stud is electrically connected with the cable when the car passes over it by means of a plunger which normally is held away from the cable by a spring. When



A STRETCH OF THE COMPLETED LINE

the magnets on the car pass over the stud plate, the plunger is magnetically drawn down to the cable and current is led to the plate. After the car has passed the stud plate, the plunger is drawn back out of contact by its spring.

The collecting device on the car consists of a chain of triangular iron links connected at each end with the electro-magnets carried on the car. When the car passes over a stud the links move down and make contact with it; after passing a stud the links are drawn up out of contact with the pavement by means of springs. A storage battery of nine cells connected in parallel with the magnets and in series with the motors excite the magnets in starting and serve in cases of failure of the source of current supply.

TANGENTIAL SUSPENSION FOR TROLLEY WIRE

It is a well-known fact that the trolley wheel in traveling along the wire sets up vibrations in it in both directions. If it were possible to suspend the wire freely, the wave motions thus generated would gradually diminish to zero, owing to molecular friction and air resistance; but in practice the trolley wire is more or less rigidly held, thus causing the vibratory forces to be damped at the ends of the trolley ears, which are also subject to the hinging action of the trolley wheel. Eventually these movements cause crystallization and induce breakage of the wire. The catenary system of suspension has been brought out largely to secure this desired flexibility. Another method, designed to secure the same results, but adapted to existing pole construction, or elsewhere, where the catenary construction cannot be used, has recently been employed in Burton-on-Trent, England, and is the design of P. J. Pringle, borough engineer of that system. It is adapted for both side and span construction.

At equal distances on each side of the bracket arm Mr.

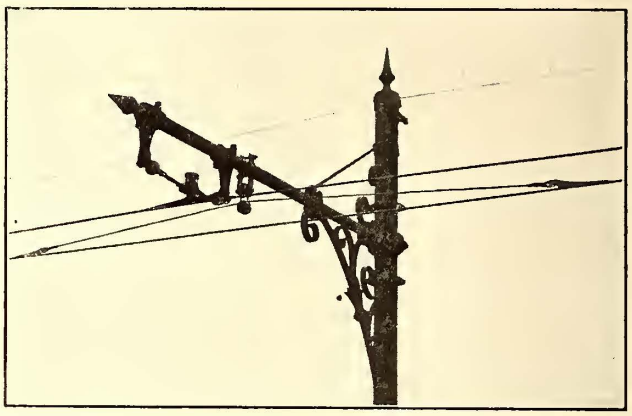


FIG. 1.—OLD AND NEW SUSPENSIONS ON SAME POLE

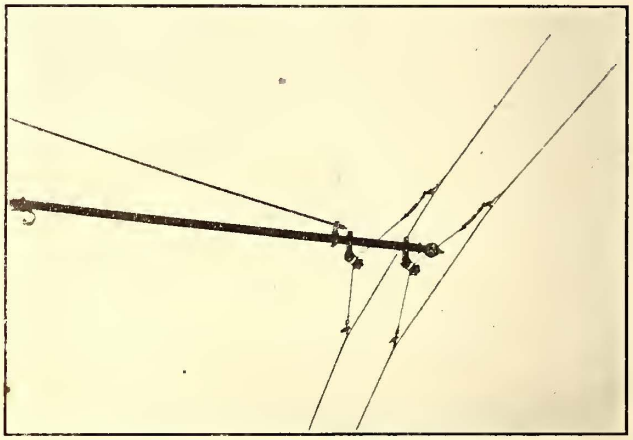


FIG. 2.—NEW SUSPENSION ON CURVES

FIG. 3.—MULTI-SUPPORT ON SPANS

Pringle anchors the trolley from a messenger wire which in turn is carried over a porcelain spool hung from the bracket arm. Thus the trolley wire is suspended almost as freely as in the center of spans and the sag between the spans is reduced. The distance between the two ears is about 10 ft. and the entire point of the suspension is 4½ in. to 6 in. clear of the trolley wire. The great differences in the two systems as applied to bracket arm suspension are plainly shown in Fig. 1. The outside trolley wire supported according to the common method shows a common form of "flexible bracket" construction, whereas a single insulator

and bracket serve for the tangential suspension. The ears on the latter are 8 in. long and the grooves are milled out a trifle larger than the trolley wire, both being tinned before soldering is begun. Two small clamps hold the wire tightly in the groove, so that the two surfaces are in true contact. Tests made with No. 000 wire soldered into 8-in. ears have broken the ear casting without any sign of failure from the soldering. In testing with 12-in. pull-off ears, the trolley wire was fractured at 6000 lb. without causing the solder to fail. These instances are quoted by Mr. Pringle to prove that proper soldering of the ear gives ample strength. He also believes that the more expensive gun-metal ear can be safely replaced by the soldered malleable iron ear.

Fig. 2 shows the application of this method on bracket arms at curves. This is especially interesting since the two-point flexible suspension reduces the degree of curvature otherwise required and thereby permits high speed with greater safety.

An elaboration of the tangential suspension is shown in Fig. 3, where the old and the new methods are shown as applied to span construction. In this case the span wire carries an insulator with several grooves, each groove carrying a messenger wire to which the trolley is attached through soldered ears. Thus it is possible to secure a double or triple tangential suspension to reduce the sag between spans to any desired minimum. The adoption of this system on present lines is an extremely simple matter since it is applicable to any wire section, does not require new copper and can be applied gradually without interfering with the rest of the installation.

In addition to the installation mentioned in Burton-on-Trent, 3 miles have been built at Derby on both span and bracket construction. The various supplies required in connection with this method are made by the Consolidated Accessories Company, of London.

INSULATORS FOR EXTREMELY HIGH VOLTAGE LINES

BY F. M. LOCKE.

The frame type insulator, shown in Fig. 1, is one which I have designed for lines requiring 150,000 volts, line pressure. It will stand a spray test of 280,000 volts, leaving a large factor of safety. It will carry a mechanical load of 20,000 lb., and can be constructed to carry as much as desired by increasing the I-beams and side rods and the bearing surface of the porcelain. The frames are interlocked like a chain and the line cannot come down. All the porcelain parts are under compression and are designed to have a surface large enough to carry the required mechanical load with a large factor of safety. Under an electrical test this insulator does not show the usual static stresses, and is extremely quiet up to the arcing point, which takes place between the frames. In case of an arc from lightning, the arcing will occur between the frames and not injure the insulator. These insulators are furnished in any size for line voltages from 70,000 volts up to 300,000 with a factor of safety of two under a spray test, and any mechanical load desired. As will be seen, this is the only insulator made with which unlimited test voltage, unlimited mechanical strength and an unlimited factor of safety on all points can be secured. It is designed for the hanging type, but can be supported at either end, and used horizontally or perpendicularly. It is manufactured exclusively by the Lima Insulator Company, Lima, N. Y., under my rights of patent which are now pending.

Fig. 2 illustrates my 450,000-volt, 150-kw transformer which I use to test the insulator described above. It is installed at the Lima Insulator Company's plant and was made by the Central Laboratory Supply Company, La Fayette, Ind.

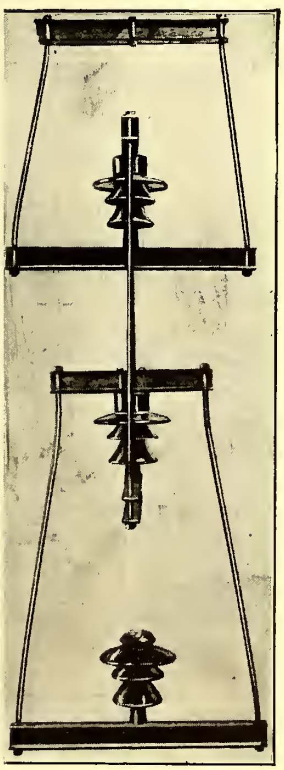


FIG. 1.—FRAME TYPE INSULATOR

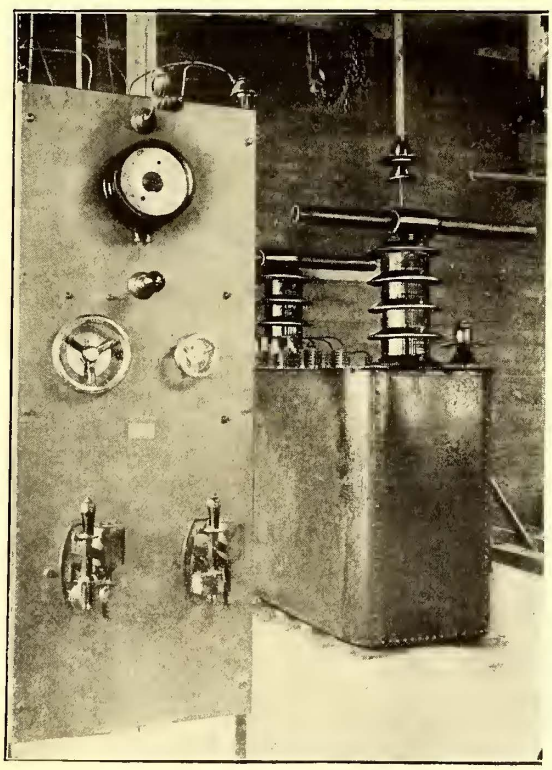


FIG 2.—450,000-VOLT, 150-KW TRANSFORMER FOR TESTING

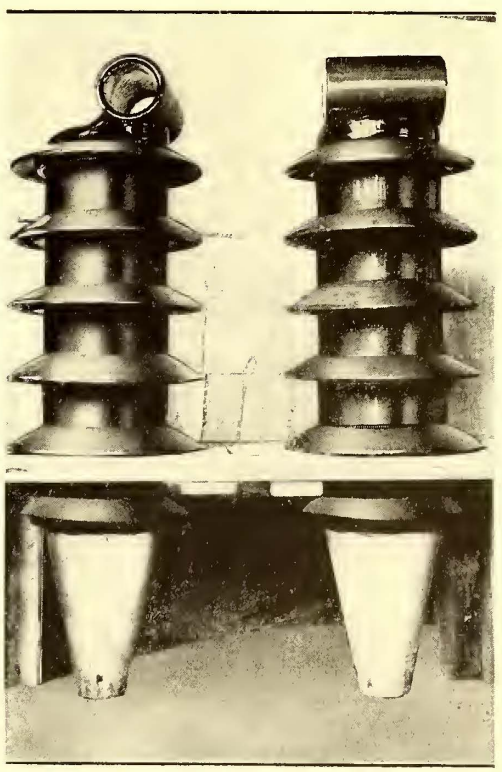
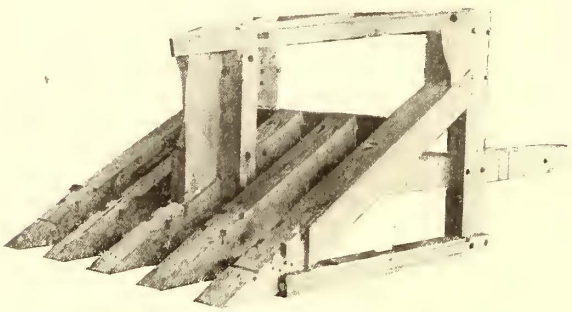


FIG. 3.—PORCELAIN BUSHINGS FOR INSULATING LEAD WIRES OF 450,000-VOLT LINE

Fig. 3 shows porcelain bushings manufactured by the Lima Insulator Company for the Locke 450,000-volt, 150-kw transformer and is insulating successfully the lead wires. These bushings are oil filled and the holes through the top caps are to support the choke coils at each terminal. They weigh about 200 lb. each.

PLOW WITH LONG RECORD OF SERVICE

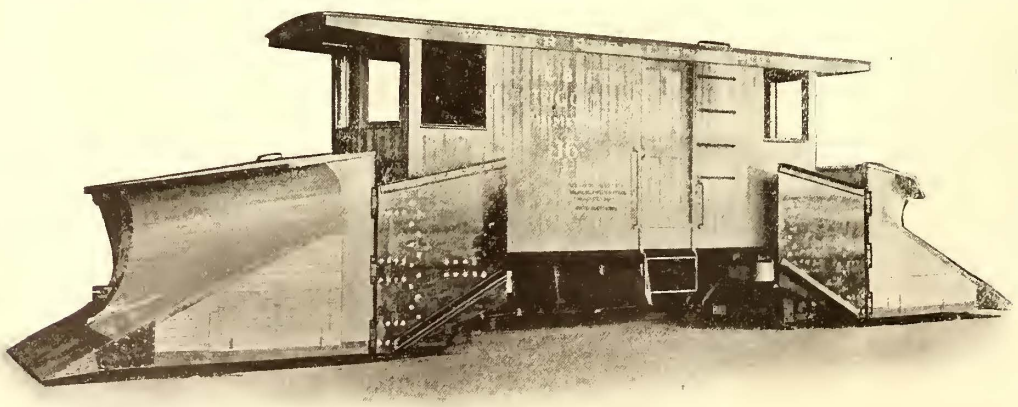
A record of five years of service on city, suburban and interurban lines over curves of even 45 ft. radius and grades up to 8 and even 13 per cent without expenses for repairs either to the plow or the equipment is claimed by the Wilder Snow Plow & Manufacturing Company, of Worcester, Mass., for one of its plows. It is further said of this machine that it used not more than a barrel of sand and



FRAME OF PLOW

no salt for the hardest day's work, with a crew of only two men, and maintained a schedule speed of from 8 to 20 miles per hour, through snow from 1 ft. to 6 ft. deep. The maintenance charges during the five years were limited to the cost of transferring the equipment to and from the plow to open cars, and the cost of inspection, oiling and painting.

A Wilder radial snow plow built for the Cape Breton Electric Company, Ltd., Stone & Webster Engineering Corporation, general managers, is illustrated herewith. The plow is known as Std. style, Size No. 1, Style A, single track. It weighs 38,000 lb. without ballast and electrical equipment. The timber entering into its construction was of oak and yellow pine. It has double glass windows and is equipped for air throughout, the noses, wings, scrapers,



PLOW FOR CAPE BRETON ELECTRIC RAILWAY

sanders, brakes, etc., being in complete control of the motorman. The general dimensions are as follows: Length, 40 ft. 6 in.; extreme height, 11 ft. 8 in.; height moldboard, 6 ft. 6 in.; width, 8 ft. 4 in.; width wings out, 12 ft. 4 in.; truck wheel base, 6 ft. 6 in. The wheels are 33 in. with 7/8-in. flange and 3-in. tread. The axles are cold rolled, 4¼ in. in diameter and the journals 3¾-in. x 7-in. M. C. B. Standard. The equipment includes Westinghouse air equipment, Symington journal boxes, Ajax brasses, Wilder pneumatic sanders, Ridlon overhead gongs. The plow is painted traction yellow with aluminum lettering.

TURBINE PLANT FOR CAIRO

Willans & Robinson, Ltd., of Rugby, Eng., have recently shipped a turbo-alternator to Cairo for the Cairo Electric Railways & Heliopolis Oasis Company to supply power for working a railway in the suburbs of Cairo running out into the Heliopolis Oasis. The turbine is of 3000-kw normal capacity, running at a speed of 1500 r.p.m., and is capable of an overload of 25 per cent for two hours and 50 per cent for short periods. It will work with steam at 176 lb. pressure at the stop valve, 190 deg. Fahr. superheat when exhausting into a vacuum of 27 in. to 28 in. with the barometer at 30 in. The turbine, which was built to the specifications of A. Della Riccia, of Paris, is of the Willans-Parsons type and contains the distinctive features which have been developed by Messrs. Willans & Robinson, among them blading built up in segments so as to be removable and interchangeable, and the special method of balancing, avoiding the necessity of a large diameter balance piston at the high-pressure end in the position where the large variation of temperature is liable to give cause for distortion.

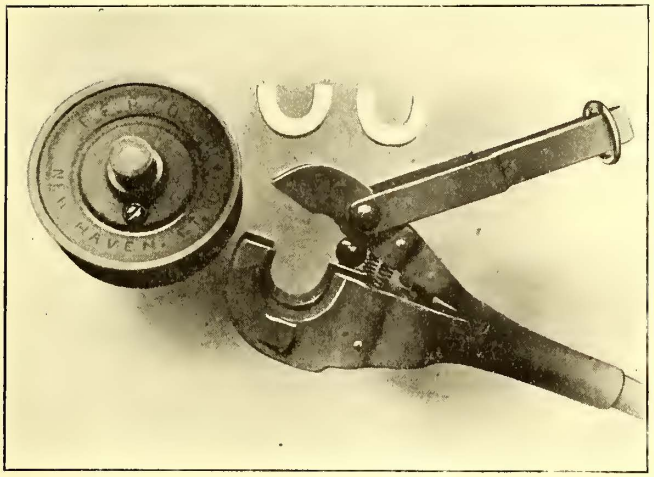
The turbine is direct coupled to a three-phase alternator manufactured by Dick, Kerr & Company, of London and Preston, which is capable of giving the full load output at a pressure of 10,250 volts with a power factor of 0.8. The generator is fitted with a direct-coupled exciter and the set is arranged to be electrically controlled and governed from the main switchboard.

The turbine exhausts into a surface condenser of the Willans "Contraflo" type arranged to work with warm circulating water under tropical conditions, the vacuum varying between 27½ in. and 28½ in. with the barometer at 30 deg. The condenser is fitted with a three-throw air-pump driven by means of a three-phase low-pressure induction motor. Circulating water is supplied to the condenser by means of a self-regulating vertical centrifugal pump of the Rees Roturbo type, coupled up to a three-phase motor, this arrangement being adopted to prevent danger to the motor through flooding.

The order for the turbine necessitated the making of a new standard size to comply with the special conditions, but despite the fact that complete new drawings and patterns had to be made for every portion of the turbine and condensing plant, the work was executed in 156 days. An idea of the amount of work handled in the above time may be gathered from the fact that the weight of the complete consignment when shipped was 145 tons. The plant will be delivered to Alexandria by steamer, transferred to barge, and taken up to the power station at Choubrah, near Cairo.

A NEW ACCESSIBLE HARP

A trolley harp that makes the trolley wheel readily accessible for removing and inserting a new one or for replacing the wheel with a sleet cutter has recently been perfected and is now being placed on the market by the Recording Fare Register Company, of New Haven. In its details the new harp differs materially from trolley harps as ordinarily constructed. Instead of turning on a pin driven through



WHEEL REMOVED FROM HARP, SHOWING PARTS

the forks of the harp, the wheel and pin turn in suitable bushings in the harp proper, which is split horizontally and hinged midway of the shank, so that the upper part may be readily lifted and the wheel and pin inserted in the lower or fixed arm. The bearings that support the wheel are grooved on their underside and lie in recesses in the lower arm of the harp. They can be readily replaced. Projecting lugs on the branches of the upper arm engage recesses in the branches of the fixed arm and prevent lateral displacement. There are springs in the harp proper just back of the wheel

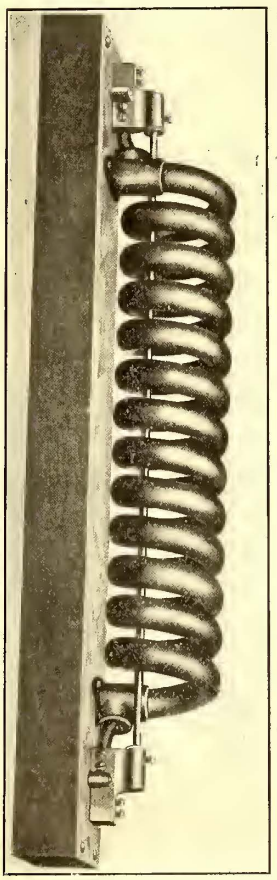
WHEEL READY FOR SERVICE

bearing which serve to hold the upper and lower members of the harp in place so that the wheel cannot be displaced should the pole jump the wire violently. The trolley rope is attached by means of a ring to a bail fixed to the upper arm of the harp. This bail tends to hold the members firmly together by locking them and also serves as a ready means of lifting the upper members against the resistance of the spring when it is desired to remove the wheel. In addition the bail acts as a trolley finder by making it impossible for the wheel to engage the trolley wire from above. A very valuable feature of the harp is the slight expense for maintenance, there being no contact springs, contact washers or steel spindles to replace. There is also the saving in labor required to replace parts and for changing wheels.

A NEW LIGHTNING ARRESTER

New and somewhat radical means for protecting electrical apparatus from the injurious effects of lightning and for doing away with the accumulation of static charges induced in exposed transmission lines by lightning are provided in a new line of Garton protective devices which the Lord Electric Company, of New York, is placing on the market. In designing the new protectors full advantage has been taken of the fact that bends and kinks in a conductor offer a certain amount of impedance to a discharge, that a series of coils also has a very high inductive effect and that a discharge is also impeded if the conductor is surrounded by an iron tube.

In the new protector, which is made in four standard sizes, the conductor, thoroughly insulated, is placed in a helical tube so as to combine the inductive effect of the coil of wire and the metal sheath. The result is that a discharge seeks the surface of the metal sheath, leaving the conductor rather than pass through or over the various convolutions. To aid the metal sheath to dispel the static charge a discharge rod crosses each of the convolutions, but is insulated from them and is connected to earth through a circuit interrupter. Thus by induction all excessive currents are taken off the line and discharged to earth. It is also possible to connect the sheath directly with earth without the use of the discharge rod, but this method of discharging the sheath has not proved as satisfactory as that of employing the discharge rod.

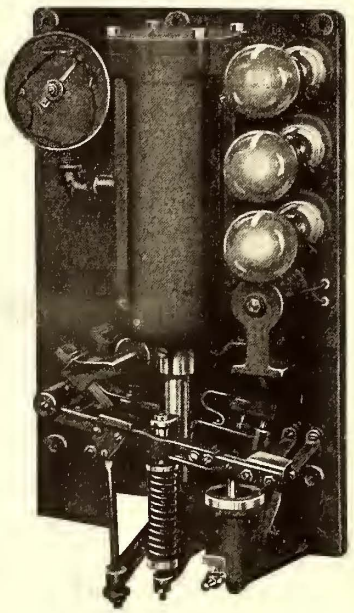


CHOKE COIL ARRESTER WITH DISCHARGE ROD

The protector is designed for direct-current service and is made in four sizes. When placed in series with the trolley and connected with the regular lightning arresters and grounded through the discharge rod, it is claimed to offer almost absolute protection to railway motors. Smaller sizes are designed for watt and voltmeters and other delicate instruments, and it is said that in several stations where the windings of such instruments were constantly being burned out, the employment of the new arrester entirely overcame the difficulty. The patent discharge rod feature may be attached to other forms of choke coils made by the company, if desired.

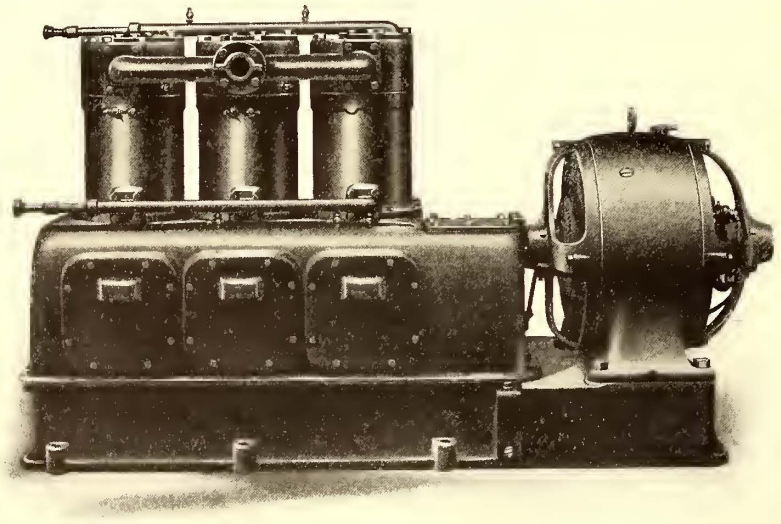
NEW MOTOR-DRIVEN AIR COMPRESSOR

The demand for a compact, economical air compressor of moderate capacity to supply industrial plants, car shops and other works has led the National Brake & Electric Company, Milwaukee, Wis., to design and build a new line of multi-cylinder, motor-driven compressors having capacities of from 50 to 225 cu. ft. of free air per minute. They are designated as type "3 V S" and are furnished with either a. c. or d. c. motors, or adapted for water wheel or belt drive. Single stage compression is employed and three vertical cylinders, cast separately, are used for all four sizes. All working parts are entirely enclosed to protect against dirt and mechanical injury.



AUTOMATIC STARTER FOR DIRECT-CURRENT COMPRESSOR

The main frame is cast in two pieces, the upper and lower halves being accurately machined and fitted. The lower half carries the crankshaft bearings and serves as a storage chamber for the oil used with the splash system of lubricating the moving parts. The motor is mounted on an extension of the lower half of the frame so that it is always in proper alignment. Doors in the side of the upper half of the frame provide means for getting at the crankshaft and connecting rods for inspection or adjustment.



100 CUBIC FOOT "3 V S" TYPE AIR COMPRESSOR WITH DIRECT-CURRENT MOTOR

The driving power is transmitted from the motor shaft to the cast steel crank shaft by herringbone gear and pinion made in halves and accurately cut before being riveted together. The gear is of open hearth steel and the pinion of special tool steel. The connecting rods are of cast steel with solid wrist pin ends, bored out and fitted with lumen metal bushings which can be easily removed when worn. The crank pin end is also fitted with lumen bushings and shims are provided to take up wear.

Trunk pistons are used in the cylinders, each piston being fitted with a self-adjusting metallic packing ring so that no stuffing boxes are required. The cylinders are cast from hard close-grained iron, carefully bored and smoothly finished. The clearance of the pistons has been reduced to a minimum which increases the efficiency of compression correspondingly. Both the inlet and outlet valves are fitted in the cylinder heads and are connected by manifolds to single inlet and discharge pipes. Discharge valves are of the tubular type cut from solid stock and are interchangeable. The suction valves are of the disk type, and have been designed to give minimum clearance space. Any of the valves may be removed without interfering with any others by removing the valve caps in the cylinder heads. Both the cylinders and cylinder heads are water jacketed with a continuous circulation of water from the inlet at one end of the row of cylinders to the outlet at the other end. Pet cocks are provided to drain the jackets when necessary.

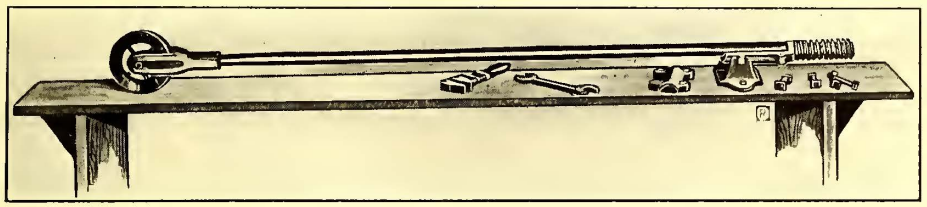
The splash system of lubrication is employed to oil the crank shaft and connecting rod bearings. The driving gear is partially submerged in the pool of oil in the bottom half of the frame and automatically lubricates itself and the motor pinion as well as the outboard bearing. The piston wrist pins are oiled by an ingenious device consisting of a long tube with a steel ball valve at its bottom end fastened to the connecting rod, and with its upper end forming a spout over oil holes in the wrist pin bearings. Oil is forced up in this tube by the downward churning of the connecting rod in the storage pool and flows out at the upper end, flooding the wrist pin bearing. The action is entirely automatic after the compressor is started.

The d. c. motors furnished with these compressors are of the company's standard C. S. type having four poles and being heavily compounded for starting under full line voltage without damage. The motors range in capacity from 10 to 40 hp. When desired a. c. motors of suitable design are furnished for either 25 or 60 cycle current, two or three-phase circuits, and 200, 400 or 550 volts. Automatic starters for both a. c. and d. c. motors are also furnished. The air governors on these devices can be adjusted to cut in or out at any desired pressure within the capacity of the machines. The machines are designed for continuous service at 90 lb. pressure, but can be furnished for pressures up to 150 lb. at a slightly reduced capacity rating.

BAYONET TROLLEY BASE

The cost of trolley maintenance is not always estimated in the amount of money expended for renewals of wheels, harps and poles, but the time taken to make repairs; the loss of car earnings on account of a broken pole or damaged wheel blockading the entire system at a time when traffic is heavy often figure very large in the expense bill. With a view toward the elimination of these losses to a large degree, a number of improvements in trolley equipment have recently been introduced by the Bayonet Trolley Harp Company, of Springfield, Ohio. This company's detachable harp has already been described in these columns. Its principal advantage is the quick removal of a damaged wheel and the adjustment of all parts to each other.

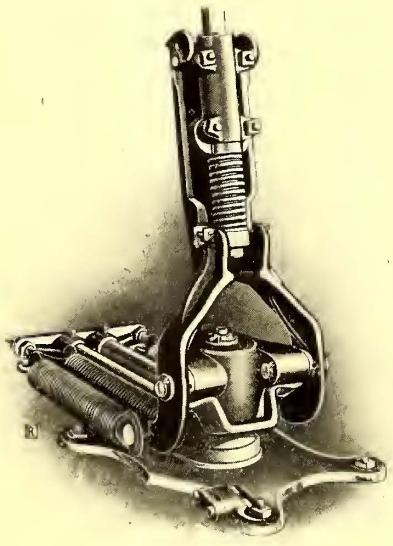
The company's new base, illustrated herein, has been designed to overcome delays caused by broken trolley poles. It is provided with two sets of very large rollers in its bearing, acting independent of each other, so that it has a sensitive motion. The large diameter of the rollers also prevents binding or seating. Any tendency toward pitting



COMPLETE POLE UNASSEMBLED

of the rollers is overcome entirely by the sliding contact between turret and base plate. The spring tension is equally divided on either side of the arms of the yoke, and equalizers proportion the pull over all springs equally. The terminal fastenings are very simple, as no set or cap screws are used.

The pole arm has a trough-like extension provided with two sets of hook bearings oppositely directed toward each other. The lower set receives the trunnioned abutment collar through which passes the tail piece of the detachable pole clamp. The upper set of bearings receive the projections on either side of the clamp, which is held in position by means of the heavy compression spring attached to the tail piece of the clamp. The clamp is further provided with a safety latch which prevents the release of the pole in case of backing the car. The pole is attached by pressing the tail piece of the clamp down through the abutment collar until the projections on the clamp engage the upper bearings, when the heavy compression spring and the safety latch automatically lock the pole and clamp in the arm.

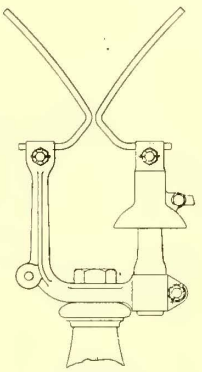


TROLLEY BASE

Another feature of value claimed for the pole is the method of getting the trolley wheel in alignment with the overhead wire. This is all done at the work bench in the manner illustrated by means of a plane surface, a trunnion rack with bearings corresponding with the upper bearings in the pole arm, a harp and wheel on the tip end of pole, and the projections of the clamp resting in bearings of the rack. All that is then necessary is to tighten the bolts as any other pole clamp. The time required is only about three minutes. Good alignment and a sensitive motion of the base of course not only improve the contact but are the principal factors in preventing the wheel from leaving the wire.

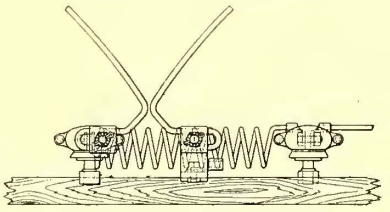
HORN LIGHTNING ARRESTERS

The Siemens-Schuckert Works, of Berlin, Germany, are offering two styles of lightning arresters, one suitable for protecting line circuits of electric railways and the other for protecting car circuits.



POLE TYPE ARRESTER

The principal parts of the line arrester consist of two divergent horns of hard drawn copper wire placed in the same perpendicular plane and carried on a support screwed to the top of the pole. Both horns are fastened by clamps and the one on the left is grounded directly through the supporting casting and the pole. More effective grounding can be secured by attaching a grounded wire to an ear provided in the casting. The right horn is clamped to a special insulator, the cap of which is screwed on to a hard rubber pin with a steel center. Double insulation is thereby afforded, since the covering of the pin will serve for insulation should the cap insulation be ruptured. The shape of the cap is such that the pin is protected from excessive arcing.



CAR TYPE ARRESTER

The distance between the horns may be varied by moving them along the grooves in which they are clamped. The arrester is connected to the circuit to be protected through the lip shown on the right of the insulating cap. If no grounding plates have been provided and the arrester is grounded on the running rails, it is advisable to make the connection to the rails with grounding wires at least 8 mm in diameter.

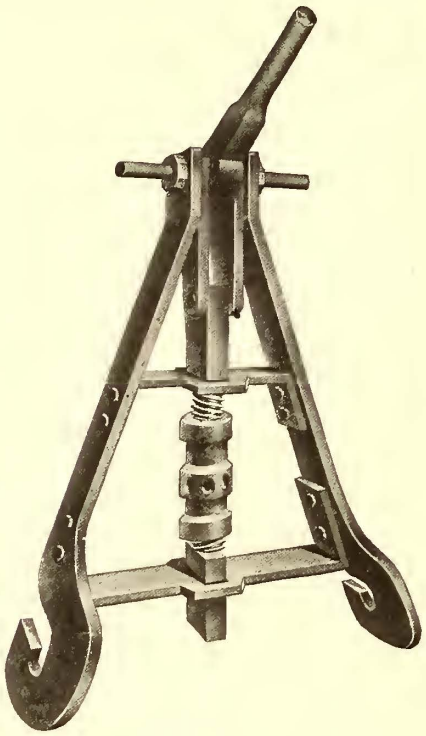
The car-type arrester, as shown in one of the illustrations, also consists of two copper horns, of which the left one is fastened to a hard rubber insulator and is connected with the working circuit through a choke coil. The right horn is grounded through the trucks. The horns are fastened by clamps and like the line arresters, have an air gap of 3 mm to 4 mm on 500-volt to 600-volt potentials.

The lightning arresters operate as follows: Lightning on discharging through the arrester will form an arc over the air gap of the horns and then go to ground. The arc thus caused induces a short circuit between the trolley and rails, which results in such electrodynamic action of the horns that the arc is blown strongly upward and is extinguished finally because of its continued elongation. This dynamic action is reinforced by the movement due to the heating of the surrounding air. The blowing out of the arc is accompanied by a powerful report for a fraction of a second, and then the arrester is prepared to take another discharge without any adjustment.

Judge Lacombe, of the United States Circuit Court appointed, April 1, Frederick W. Whitridge temporary receiver of the Union Railway Company, of New York.

A RAIL BENDER FOR HEAVY RAILS

A special rail bender for heavy girder and T-rail, differing materially from its rail benders for light work, and even from the ones designed for use on rails up to 100 lb., is being made by the Pittsburg Pole & Forge Company, of Pittsburg, Pa. The new bender is known as the Pittsburg



RAIL BENDER FOR HEAVY RAILS

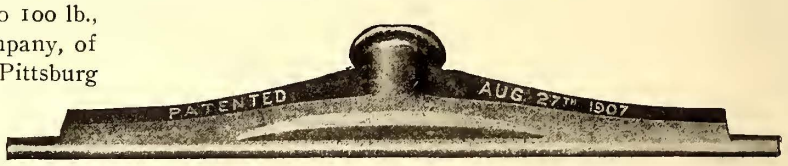
eccentric. It is made in four sizes, Nos. 1, 2, 3 and 4, for use respectively with 80, 90, 100 and 110-lb. rail and weighing with wrench 180, 200, 225 and 250 lb., according to the class of service for which it is intended. As shown in the accompanying illustration, the bender is very simple. It consists merely of a pair of upright members with feet at the bottom for receiving the rail. An eccentric and lever at the top provide means for bending the rail through a central shaft. The latter has a turn buckle by which the exact degree of curvature desired in the rail can be secured.

A NEW TROLLEY EAR

The Chester Supply Company, of Chester, Pa., has recently placed on the market an improved trolley ear known as the Dyer, in which the wire is secured in the ear by the

INSIDE VIEW OF TROLLEY EAR

lip being turned over the wire after the wire has been fitted in the groove. This makes both a mechanical and electrical joint and does away with all soldering. The company has a clamp which shapes the wire to the seat of the ear and admits of its being placed therein by one man in about two and one-half minutes, thus reducing the cost of labor in both repairs and new work. The special construction permitting a brace from the center to the end of the ear offsets the kink by the strain of a pull-off wire. The material used for the ear is of a special formula which

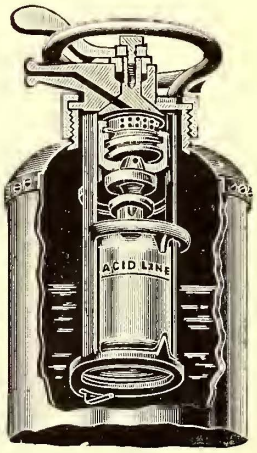


OUTSIDE VIEW OF TROLLEY EAR

contains 86 per cent of copper and 14 per cent of metals, which insure the longest life. The length of the ear is 10 in.

FIRE EXTINGUISHERS

A hand fire extinguisher which has been adopted widely for electric cars and which possesses a number of novel features is illustrated in the accompanying engraving. It is manufactured by the O. J. Childs Company, of Utica, N. Y. An important feature of the extinguisher is that it has a stop cock outlet in the cap and the lever that opens and closes this stop cock also operates the stopper which corks the bottle of acid. In other words, when the stop cock is shut off, the stopple is held firmly in the bottle, and the liquid securely in the machine until its use is required. When the stop cock is opened the stopple is lifted away from the bottle and allows the chemicals to mix when the extinguisher is inverted. This construction is considered especially desirable in the case of an extinguisher to be carried on cars where the device will be subject to a certain amount of rattle and shaking, and where the acid bottle should be kept tightly closed until the extinguisher is to be used. A hose can be employed or not as desired. Among the electric railway companies which are users of this extinguisher are the Utica & Mohawk Valley, the electrified section of the West Shore Railroad, the Auburn & Syracuse Electric Railway, the Lackawanna & Wyoming Valley Railway and the Indianapolis & Eastern Railway.



SECTIONAL VIEW OF UPPER PART OF EXTINGUISHER

The same manufacturers make the Childs Approved 3-gal. extinguisher for the protection of buildings, and among the companies which are using this extinguisher are the Detroit United Electric Railway Company, which has some 500; the Interborough Rapid Transit Company, which has 700; the Metropolitan Street Railway Company, which has 575, and the Hudson & Manhattan Railroad Company, which has 112.

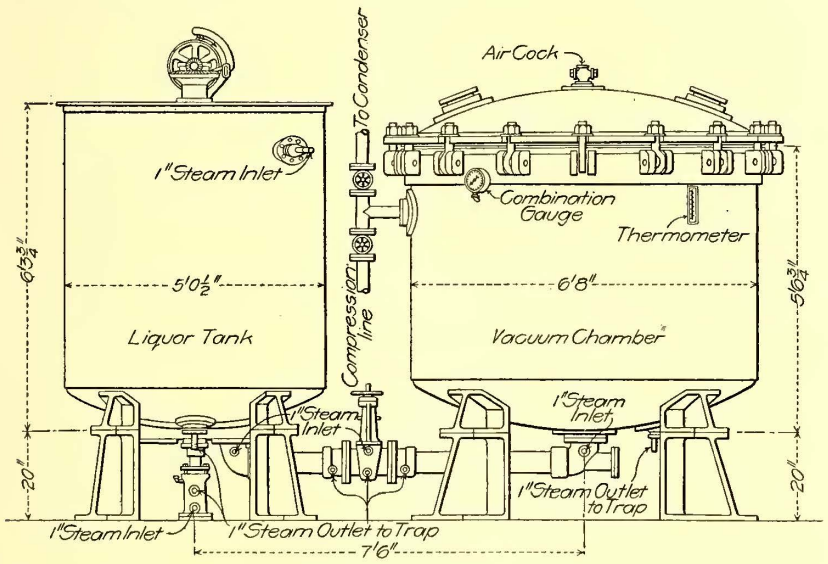
At the annual meeting of the shareholders of the Honolulu Rapid Transit & Land Company, on February 29, the following officers were elected: L. T. Peck, president; L. A. Thurston, first vice-president; J. B. Castle, second vice-president; C. H. Atherton, treasurer; Wm. Williamson, secretary. The above, including W. R. Castle and G. P. Castle, are the directors. The Henry Waterhouse Trust Company is auditor.

COIL INSULATION BY THE VACUUM DRYING AND IMPREGNATING PROCESS

One of the first users of the Passburg vacuum system of impregnating field coils was R. W. Marshall & Company, of New York, whose shops are in Brooklyn and who do a large business in general repairs for street railway companies and other users of electrical apparatus. For three years they have had in service the original vacuum set made by J. P. Devine, of Buffalo, for his laboratory, and have recently installed a new set having several times the capacity of the original one, to meet the requirements of their growing business. Owing to the interest taken in this system of insulating coils an account of the methods followed at the Marshall shops will be given.

The original unit installed consisted of an air-tight steam jacketed tank, known as the vacuum chamber, and a steam jacketed tank known as the liquor tank and used for liquifying the solid compound. The vacuum chamber of the new unit is 6 ft. 8 in. in diameter and 4 ft. 6 in. high. The liquor tank is 5 ft. 10 in. in diameter and 4 ft. high and will accommodate 18 barrels of the compound. The capacity of the vacuum chamber of the small plant is 1 ton, while the larger unit has a capacity of 5 tons. The entire operation from the time the coils enter the vacuum chamber to the time they are removed takes about 8 hours. Live steam at 150 lb. pressure is used for heating and with this they are enabled to use compound having the highest dropping point.

The coils, either old or new, having been prepared, are placed in the vacuum chamber, the inside of which is encircled by a heating coil about 1½ in. in diameter, which extends from the extreme top to the bottom of the chamber. For ordinary work the vacuum is maintained for about four hours to exhaust the air and moisture from the coils, and this vacuum is never allowed to go below 28 in. During this time the solid compound in the liquor tank, which is likewise encircled by a heating coil about 1½ in. in diameter, which extends from the top to the bottom of the tank, is given the same heat, or about 355 deg. Fahr., and the compound is then forced to the vacuum chamber and into the coils by an air pressure of about 70 lb. Of course, the compound is allowed to enter the vacuum chamber without breaking the vacuum, thus eliminating the possibility of the dried coils absorbing moisture. After sufficient time has elapsed for impregnation the compound is forced back into the liquor tank through an under pipe. The coils are then allowed to drip, and after having cooled for a sufficient length of time, the stripping tape is removed and the coils are insulated with two layers of heavy oiled muslin and bound with a layer of heavy stay binding. Last of all, they are dipped in electro-black finishing varnish and painted with an oil-repelling varnish.



VACUUM IMPREGNATING SET

Among the features of the new tank is an automatic mixing device operated from the top of the liquor tank by a 3-hp motor which constantly agitates the compound. Both units are operated from the same condenser and the same engine, but there is an auxiliary air plant. When one set is operating on vacuum the other is on air. The cover of the new tank is raised and lowered by a chain hoist just the same as the cover of the smaller unit, but is locked in place by sixteen 2-in. bolts as against eight on the smaller one, and is fitted with a rubber and asbestos gasket to seal it against the entrance of the air. The observation glasses of the new tank are in the cover, and one of them is fitted with an electric light so the interior can be readily viewed. In the original unit the glasses were in the side and the splashing of the compound often made it impossible to look into the tank. The pipes connecting the tanks are all jacketed and there is a jacketed gate valve between the liquor tank and the impregnating tank.

Marshall & Company claim that coils treated in this way have the following advantages:

(1) They are absolutely impervious to moisture.

(2) They will stand a much higher voltage test, owing to the coil being thoroughly impregnated.

(3) The ordinary term "mumified" is quite appropriate, because a coil thus treated is an absolutely solid mass and there is no possibility of the individual wires vibrating and wearing the insulation from one another, which is frequent with ordinary fields, for the solid compound holds the wires in their relative positions.

(4) The solid compound acts as an excellent conductor, and impregnated field coils radiate heat much more easily, thus reducing the normal temperature.

Old field coils can be successfully rejuvenated by this system if they are not dead short circuited at any point in the coil.

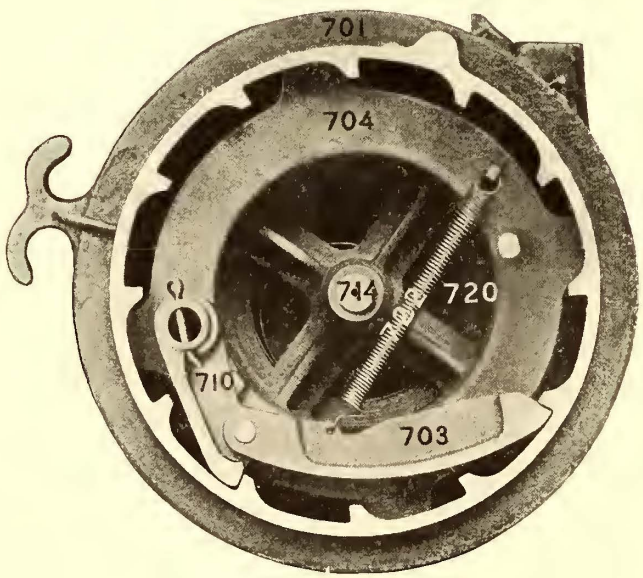
A number of very novel and practical ideas in the method of handling this work are in use by Marshall & Company. Among their shop equipment, for instance, are three steam-heated armature coil presses designed and built especially for them. On the entire four sides of the coil the plates are hollow and filled with steam at very high pressure and they are operated by air, which gives very high pressure and enables the operator to turn out coils very rapidly.

The receivership for the Westinghouse Machine Company, created last October, was vacated March 31 by Judge James S. Young, of the United States Circuit Court, on petition of the company and the receivers. The property was turned back on April 1 to the stockholders, and the company will begin its fiscal year free from debt, with cash in bank. It is said to have orders to justify operating the plant on about a 75 per cent basis, as has been the case all through the receivership.

A NEW TROLLEY CATCHER

The Lord Electric Company, of New York, which makes the Earl trolley retriever, has just brought out a line of Earl trolley catchers. The new device embodies a number of the features of the retriever and is said to be equally as strong and durable as that device. It is being made in two styles, known as Nos. 7 and 8, the No. 8 being provided with an emergency release. In other respects the catchers are identical.

In the engraving the No. 7 catcher is shown with the parts in their engaged positions. The check pawl 710 is pivoted to the drum and the centrifugal pawl 703 is pivoted to the check pawl. Normally both pawls revolve with the drum clear of the teeth, as the drum turns back and forth to pay out and take in slack rope under the action of the tension spring 720. When the trolley jumps the jerk on the rope causes the centrifugal pawl to fly out and engage one of the teeth in the back, and as the drum rotates further the check pawl 710 is forced out into engagement with another tooth, thereby positively checking any further upward movement of the pawl. The drum is not locked by the engagement of the pawls with the ratchet teeth, but merely checked to prevent the further unwinding of the rope, and should the trolley pole strike a span wire



CATCHER WITH PARTS ENGAGED

and be brought to a lower position the drum will immediately take in the slack rope and the pawls will re-engage to check the pole in this lower position. In these devices the desirable feature of positive catch is incorporated. Furthermore, it will be appreciated that the thrust or blow by reason of the sudden jerk of the trolley is minimized by this union of clutches together with the elasticity gained by reason of the centrifugal pawl spring. The emergency release of the No. 8 catcher consists of a ratchet ring having internal and external teeth, the latter being engaged by a release lever. When the end of the release lever is depressed the ratchet ring is free to turn and the pole may then be run up to the wire at any speed.

Although the catcher has just been placed on the market the company has already received an order from a large city railway for 1650 catchers and an order from another city for 200 catchers, besides many small orders.

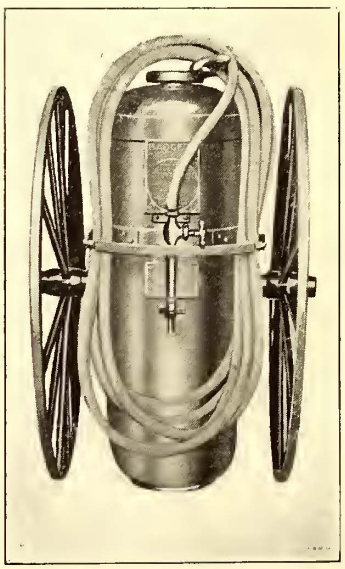
A RIFLED TROLLEY BUSHING

The H. B. Ives Company, of New Haven, which makes the New Haven trolley wheel, has adopted a very simple method of providing bearings for its wheel. It now rifles the wheel itself by means of special machinery, eliminating the particles of scale, sand and grit common to cast bushings. The groove is then filled with the company's special lubricating compound and requires no oil. The wheels are made in different sizes for high-speed interurban and city lines. They are used quite extensively in New England and are in general use throughout the East and West. The company has manufactured the wheels for the past five years and also manufactures a line of register fittings and car trimmings, and has heretofore marketed them indirectly. Since the first of the year, however, it has extended this branch of its business and is now soliciting trade direct. A catalogue of trolley wheels, car trimmings and register fittings, just issued by the company, gives details of all the company's street railway specialties.

RIFLED TROLLEY BUSHING

SMALL FIRE EXTINGUISHER WITH CARRIAGE

A small fire extinguisher mounted on a truck and especially adapted to the protection of street railway property is made by the Badger Fire Extinguisher Company, of Boston. The tank is of steel with a heavy sheet-lead lining thoroughly attached to the steel shell, so that only lead is exposed to the solution. This form of construction retains the strength of the steel and insures against corrosion. When not in use the extinguisher stands on end with the wheels off the ground, but it can be readily pulled over on to the wheels. The narrow gage will allow it to go through any 3-ft. door or on an elevator. In putting the machine into action the top is dropped to the floor. This allows the stopper to fall away from the acid bottle and the acid to run into the soda solution, generating carbonic acid gas. By the time the hose is laid the pressure is generated. A stream can be thrown about 75 ft. beyond the nozzle through 50 ft. of hose. Each engine is tested at 500 lb. cold water pressure. The charge consists of 20 lb. bi-carbonate of soda and 7 lb. sulphuric acid, and the equipment comprises 50 ft. of ¾-in. chemical hose with patent shut-off nozzle.



SMALL EXTINGUISHER READY FOR SERVICE

With the mounted extinguisher and the smaller Badger's extinguishers very effective means are provided for suppressing a blaze.

LONDON LETTER

(From Our Regular Correspondent.)

The General Purposes Committee of the London County Council is so satisfied with the increasing good results of the tramway system that it has recommended the Council to increase the salary of Mr. Fell, the chief officer of the tramways, from £1500 to £1750 a year. It is evident that the Council does not propose to let any opportunity pass by which intercommunication of the tramways on the south side of the river can be made with those on the north side, and the success of the tramways over Westminster Bridge has been so great that the Council is all the more anxious to get other connections of this kind. When Blackfriars Bridge is completed the success of the Embankment Tramways will be all the greater as there will then be a long loop line instead of a dead end on the embankment near Blackfriars Bridge. As it is now apparent that the corporation of London will in the course of the next few years rebuild Southwark Bridge the Council has already approached the Court of Common Council with a proposal for the running of trams over this bridge when it has been rebuilt, thus forming another link between the north and the south. This bridge, though a beautiful one in many ways and of great service at the time it was built, is not of sufficient service at the present, owing to its extremely steep grades and it is therefore reasonably sure that the bridge will be rebuilt before long. A service of trams across this bridge would make a very valuable connection between the south side and Queen Victoria Street and eventually perhaps along new Bridge Street and Farringdon Street, thus connecting with the whole northern system. It is also interesting to note that the laying of electric mains on Putney Bridge, some 5 or 6 miles further up the Thames, for the projected system of tramways of the Council from Harlesden through Shepherd's Bush and Hammersmith to Putney has been begun and this will also form a valuable link between the northwest and the southwest of London. The first trial trip of the tramways on the route between Burdett Road and Whitechapel Church, which has been equipped on the G. B. surface contact system, as described elsewhere in this issue, took place this month, and though the service is not yet open to the public it is understood that the experiment was quite successful.

The reports of the various electricity supply companies, of London have all been published within the last few weeks, and while I do not desire to refer to them in any ordinary way in this column it is interesting to note that in the reports of most of the larger of these companies reference is made to a bill which these companies are promoting in common with the view of settling the question of the bulk supply of electric power in the metropolitan area. It will be remembered that the London County Council's bill was rejected last year by the House of Lords and that there is another bill by an outside syndicate to be presented this year seeking powers for the supply of electricity in bulk. It has appeared, therefore, to the existing companies that the best method of settling this question is to promote a bill in their own interests which will give them mutual rights to help one another in the way of exchanging current. This bill represents eight London electric supply companies, the chief object being to render mutual assistance, and at present most of the expense of installation connected with the bill would be the laying of a large network of mains joining up the chief stations of these various companies. It seems a reasonable way out of the difficulty and undoubtedly there are sufficient electricity supply companies in London to provide all the electricity that is required and with this mutual assistance there ought to be procurable any quantity of electricity desired at extremely reasonable rates. The amount of capital involved would be very much smaller than that of inaugurating a complete new system and the existing companies and municipal boroughs operating their own plants would in this way be protected.

We referred last month to the improving condition of the various tube railways in London, and it is very interesting to note that an arrangement has now been made with the various tubes to issue through tickets on all the underground systems of London. This embraces the Baker Street & Waterloo, Central London, Charing Cross, Euston & Hampstead, City & South London, the District, Great Northern & City, Great Northern, Piccadilly & Brompton, and the Metropolitan railways, and as an active sign of such an agreement it has now been decided to place on the outside of each of the stations of the above-mentioned railways a large illuminated sign with the word "Underground" in large letters on it. The sign is made of glass with white letters and a blue background. It is attractive, and will undoubtedly prove to be useful. These underground railways have not been utilized to their fullest extent hitherto, but it is thought that the public will not come to associate the different lines as a complete system of railways and that the word "underground" will be used in connection thereafter instead of the name of an individual company or the word "tube." It ought to be borne in mind that these various railways are different organizations and under different management, though a number, the Yerkes group, are, of course, under one management. This amicable arrangement of all the various systems, however, will undoubtedly lead to good results, and a passenger will now be able to book at any station in London to over three hundred other stations without the inconvenience of rebooking several times. A large illuminated map of the underground system is also to be placed outside the stations as a guide to the public.

Sir Clifton Robinson, the managing director of the London United Tramways, has recently been on a tour of the world and since returning has been giving some of his impressions on tramway matters as observed in the various countries visited. From these impressions, as applicable to the tramway situation in this country, he evolves three distinct facts: first, that our cars do not travel fast enough; second, that the double-deck tramway car is the cause of much lost time, and, third, that the volume of traffic at rush hours could be handled more successfully were the authorities to remove the present restrictions regarding overcrowding. There is nothing particularly new in these deductions, as they are well known, but coming from an authority like Sir Clifton Robinson, after a complete tour of the world, they certainly ought to bear weight. The double-deck tramway car has always been a feature of British tramways, and since electrification the top deck has been covered in, making it even a little more inconvenient, and certainly very much more unsightly. In many cities, however, increased speeds have been permitted, and that situation is righting itself gradually. In many cities, also, the authorities have removed many of the restrictions during the rush hours, and standing in cars is permitted, a thing totally unknown a few years ago. We very much fear, however, that the double-deck car will remain in Great Britain for many years. The British public has got accustomed to traveling on the top of cars and omnibuses, and in fine weather enjoys the fresh air, so that even with their unsightliness the writer doubts very much if a plebiscite of the whole tramway or omnibus riding public were taken whether a vote would be recorded for the elimination of the top-deck car.

As another sign of the improvement of transportation in the metropolitan area of London, and the severe competition which has been going on between the various methods, it is interesting to record that the Star Omnibus Company, one of the smaller companies operating omnibuses in London, has issued a circular to its shareholders stating that its business has been so seriously affected by the tubes, tramways and motor omnibuses that their directors are unwilling to take upon themselves the responsibility of continuing the business. It would appear, therefore, that this company will have to go out of existence entirely. It is not only this smaller company which is feeling the competition, however, as we have frequently recorded in this column, and the London General Omnibus Company, the largest of the omnibus companies in London, which was compelled to put on a large number of motor omnibuses (although originally a horse omnibus company), by the action of the Vanguard Motor Omnibus Company in introducing a very complete system of motor 'buses in London, is also feeling the competition so severely that the profits have disappeared. Exactly the same thing has been going on with the Vanguard Motor Omnibus Company, so that now negotiations are pending between the two for an amalgamation of the two businesses. Meetings have been held for the purpose, but they have been extremely stormy, and no definite action has yet been taken. It would appear, however, that an amalgamation of the two companies is the only solution of the difficulty, as the amalgamated company would then control about 570 motor omnibuses in London. The fusion of the interests would certainly effect considerable economy in repairs, maintenance and administration, and generally tend to more effective management and control, and to stop the ruinous competition on certain routes.

The town of Luton, about 20 miles north of London, has

recently inaugurated its municipal tramway system. There are now in operation about 5¼ miles of route, equivalent to 6¼ miles of single track, and it is expected that eventually the system will be linked up with Dunstable. The corporation, however, does not propose at first to operate these tramways itself, but has provided the capital necessary, amounting to about £63,000, and the contractors for the whole system, Messrs. J. G. White & Company, Ltd., of London, have agreed to lease the tramways for a period of five or fifteen years, at the option of the Council. The rent payable by Messrs. White will be equivalent to the interest and sinking fund charged during the term of the lease. The track is of the standard 4 ft. 8½-in. gage, and side-bracket arm construction has been employed throughout. The special work, together with the points and crossings, was furnished by Messrs. Edgar Allen & Company, and twelve double-deck cars supplied by the British Thomson-Houston Company are in operation. The bodies of the cars were made by the United Electric Car Company, of Preston, and the trucks supplied by Messrs. Mountain & Gibson, of Bury. Each car is equipped with two 30-hp B. T-H motors, with the regular control gear, swiveling trolley arm, Hudson & Bowring lifeguards, illuminated destination signs, etc. The car shed has been built to accommodate sixteen cars, and is suitably provided with repair plant and stores. The power for the tramways will be supplied from the corporation's generating station.

The bill of the Belfast Corporation for the purchase of the Cavehill & Whitewell Tramway undertaking, a system just outlying Belfast, has been rejected by the House of Commons, so that the purchase of this system, for the present, at least, is postponed. It will be remembered that the corporation had decided to purchase the system for £60,000. Mr. Andrew Nance, the general manager of the Belfast Tramways, in making his recent report to the Council, made some interesting remarks about extensive inquiries he had been making into the economic value of automatic point controllers and their suitability to the work of the Belfast Tramways. He stated that he was of opinion that the best controller invented up to the present was "Tierney's," an Irish invention, and the corporation has decided to give this controller a trial at three different points of the route. This type of controller is made by Messrs. Brecknell, Munro & Rogers, Ltd., of Finsbury Pavement, London, and Mr. Nance, in recommending a trial of these controllers, states that the cost for each set is £80 fixed complete in position. He went on to say that the present arrangement with boys for operating the points costs about £1750 a year; that the capital expenditure of fitting automatic controllers to all their movable points would amount to about £3500, and the total annual expenditure, including all fixed charges with regard to that expenditure, would be about £300 per annum.

The Douglas Town Council (Isle of Man) has declined to authorize the committee to engage expert advice on the cost and feasibility of producing electricity by water-power from the reservoir to supply the town with light and work the borough tramways. To electrify the tramways on the Douglas Promenade and in the upper town would cost from £70,000 to £80,000, and reduce three-fourths of the present system, which cost £59,000, to the scrap-heap.

The Light Railway Commissioners, sitting at York, have granted the York Corporation an order authorizing the construction of electric tramways in the city, though the order was strenuously opposed by the North-Eastern Railway.

In connection with the above order it is interesting to note that as York is one of the few remaining walled cities in England, a memorial has been presented to the York City Council by the Yorkshire Architectural and York Archæological Society, protesting against the threatened encroachment on the city ramparts. In the memorial the members of the Yorkshire Architectural and York Archæological Society urge that in any measures taken for the widening of the roadway, in the interests of archæology and the preservation of the city's historic remains of mediæval earthworks, that no proposals be recommended that will in any way disturb the city embankment. They also beg that the rampart be not excavated or curtailed in any manner whatever.

The Lanarkshire Tramways Company has begun the construction of the new route from Hamilton, which, when completed, will unite with the Glasgow Corporation tramways system at Uddington by way of the historic Bothwell Bridge, where the track will cross the Clyde.

The Bolton Corporation has decided to try for a year the experiment of a parcels delivery scheme by trams. There is in that town a combined Traders' Association that is to undertake the delivery of parcels and pay the Corporation a rent of £60 a year. The Association will provide the delivery staff and other expenditure, the idea being to facilitate shopping and the interests of the commercial section of the town.

The Rochdale Tramways Committee and the Rochdale Assessment Committee have been unable to come to an arrangement as to the amount at which the Corporation tramways should be assessed for poor rate purposes, and the Tramways Committee has now decided unanimously to appeal to Quarter Sessions in the event of no further reduction being allowed. Up to about a year ago the system was assessed at £2,129, pending the completion of the system, and this figure has recently been increased to £7,861.

Mr. H. Graham Harris and Major Cardew, the two experts engaged by the Halifax Corporation to examine and report upon the Halifax tramway system, after the recent fatal accident, have written to the Tramways Committee stating that as they understood that the controllers were already being altered to one particular type, *i. e.*, that they were all being made alike, they thought it desirable, without waiting until they sent their report, to express the strong opinion that this alteration should be made at the earliest possible moment, and in no case should a car be sent out which had upon it at the opposite ends two different types of controllers, requiring absolutely opposite movements to perform the various operations which a controller had to perform in the ordinary daily work of running a tramcar. It is also interesting to note that the corporation has decided that in the next three years the tramcars shall be equipped with 35-h.p. motors instead of 25-h.p. as at present, the suggested outlay reaching £17,000. The new motors and material are estimated to cost £6,014, including £4,000 for 50 35-h.p. motors to replace the present 25-h.p. motors, and £1,100 for 50 controllers for the new motors. A. C. S.

LEGISLATION IN OHIO

Consideration of the Stockwell bill, designed to enable cities to build and own street railway tracks, has been indefinitely postponed by the House of Representatives. This was a Johnson measure intended to cover the construction work the city of Cleveland has been doing about the public square to relieve the congestion, a portion of which has been caused by the addition of the cars operated by the Municipal Traction Company. Such a fight developed in the House over this bill that the other Johnson bills stand little chance of getting through, although it is said that the Schmidt bill, doing away with the necessity of securing consents of property owners for a street railway along a thoroughfare formerly used for that purpose, has received more consideration than any of the others.

The Metzger bill, providing for a special tax of railroads and public service corporations, has been reported out by the House Committee on Taxation. This created some surprise, as it has many features of the Howe bill, which was defeated by the Senate some time ago. The bill provides that a commission of three shall be appointed to value these properties for tax purposes. The factor by which the earnings shall be multiplied to fix the value for tax purposes shall not be less than 18.81 nor more than 22.222.

At a hearing of the Howe franchise tax bill before the Committee on Taxation of the Ohio House of Representatives, a few days ago, arguments became so violent that personal encounters were evaded only by adjournment. Henry Apthorpe, representing the New York Central Railway system, and Judge C. O. Hunter, of the Hocking Valley Railway Company, in the course of their arguments against the bill, expressed some opinions of Mayor Johnson, of Cleveland, which were not altogether to the liking of his delegation in the Legislature, some of the members of which threatened to attack the attorneys if they did not cease their rebukes. The bill was at last reported out and recommended for passage. This is the Howe tax bill with certain amendments which, its friends believe, will carry it over the objections of the Senate, where it was defeated some time ago.

As a result of a conference between members of the Senate committee on cities, a new rapid transit bill will probably be introduced at Albany which will extend the maximum term for the operation of new subways by private capital to fifty years and for subway extensions thirty-five years.

TRANSFERS TO BE REDUCED IN NEW YORK

A very interesting discussion on the subject of transfers in New York has been raised by the petitions of the receivers of the New York City Railway Company and of the Third Avenue Railroad Company, to Judge Lacombe, of the United States Circuit Court, for the Southern District of New York, to discontinue transfers between the two companies. The petition of the receivers for the New York City Railway is verified by a memorandum on the subject prepared in the office of the general manager for the receivers. This memorandum contains the following table showing the number of passengers carried on all of the surface lines on the Island of Manhattan during the last twenty years, together with the average fare per passenger each year.

Year ended.	Revenue passengers.	Transfer passengers.	Per cent transfer pass. to rev. pass.	Av. fare, cents.
Sept. 30, 1888.....	193,935,484	1,996,871	1.10	4.94
Sept. 30, 1889.....	205,286,126	2,253,101	1.11	4.92
June 30, 1890.....	215,235,832	2,578,701	1.12	4.94
June 30, 1891.....	223,420,632	2,826,628	1.27	4.94
June 30, 1892.....	230,221,158	2,723,898	1.18	4.94
June 30, 1893.....	236,099,569	3,203,832	1.36	4.93
June 30, 1894.....	236,012,459	5,306,645	2.25	4.89
June 30, 1895.....	252,496,016	12,769,810	5.06	4.76
June 30, 1896.....	288,468,143	47,339,246	16.42	4.29
June 30, 1897.....	291,989,549	93,108,281	31.89	3.79
June 30, 1898.....	305,115,538	124,114,348	40.68	3.55
June 30, 1899.....	343,559,120	149,083,269	43.40	3.49
June 30, 1900.....	360,002.672	173,089,442	48.08	3.38
June 30, 1901.....	365,124,079	185,486,356	50.81	3.39
June 30, 1902.....	382,266,904	154,963,644	40.55	3.60
June 30, 1903.....	396,245,922	158,626,750	40.03	3.56
June 30, 1904.....	389,608,537	168,267,818	43.19	3.48
June 30, 1905.....	374,258,395	168,957,760	45.14	3.44
June 30, 1906.....	391,354,877	178,639,866	45.65	3.43
June 30, 1907.....	376,629,571	194,765.342	51.71	3.29
Six months ended Dec. 31, 1907.....	189,205,244	104,304.715	55.13	3.16

The memorandum goes on to state that to understand the effect of the transfer ticket law on the transportation system of the New York City Railway Company it is necessary to analyze the financial position of the company. The conduit electric system which the company was obliged to install has been a tremendously heavy financial burden, partly on account of its large initial cost, partly on account of its liability to disarrangement, partly on account of the inaccessibility of the different parts of the system for inspection and repair, and partly because as the system was new when introduced in New York a large amount of money had to be spent in experiment and in correcting defects which could not have been foreseen.

Under the interpretations which have been given to the present transfer law by the courts a practically universal transfer system has been forced upon the company. The latter has endeavored to limit the travel of a passenger to a continuous direction north and south by resorting to colors, but has been unable to prevent the use of tickets in a fraudulent manner by exchange and in other ways. Examples are given of ingenuity shown in defrauding the company through transfers by apparently respectable members of the community. The company has maintained a large force to secure evidence against persons engaged in fraudulent operations, but great difficulty has been experienced in securing conviction. A list is given of the penalties awarded as a result of the sixty-three arrests made between Jan. 1, 1908, and Feb. 22, 1908. Two persons were fined 25 cents each; thirty-five, $1 each; seven, $2 each; three, $3 each; one, $4 and one, $10. In eleven cases sentence was suspended, in one case the prisoner was sentenced to thirty days in a protectory, in one case he failed to appear and one case is still pending. As approximately one-half of the persons arrested are minors, it is difficult to secure the imposition of a heavy penalty. The following statistics for the years ending June 30, 1906 and 1907, show the increase in transfer passengers and the decrease in revenue passengers:

	1907.	1906.
Revenue passengers.....	376,629,571	391,354,874
Transfer passengers.....	194,765,342	178,639,866
Total passengers.....	571,394,913	569,994,740
Miles operated.....	57,526,567	59,400,152
Receipts	$18,635,568.55	$19,381,681.61
Passenger receipts per car mile.....	.3240	.3263

Statistics for the last six months of the two years indicate a decrease of revenue passengers of more than 5 per cent and an increase in transfer passengers of more than 5 per cent.

The memorandum continues, "Eliminating all dividends on the stock and bonds of the Third Avenue system, the guaranteed 7 per cent dividend on the Metropolitan Street Railway Company stock, the interest on Metropolitan Street Railway Company 4 per cent refunding bonds, the interest on the 5 per cent general and collateral trust mortgage bonds, and paying nothing but operating expenses, taxes, the dividend rentals, and the interest on securities of the lessor companies, there will probably be a deficit of $1,000,000 for the fiscal year ending June 30, 1908, this deficit not including any expenses incurred which are charged to construction. Speaking broadly, the surface car lines have nearly reached the limit of their carrying capacity and the increase in the number of non-revenue producing passengers will therefore operate to exclude revenue passengers. Any steps which may properly be taken to reduce the number of passengers carried on transfers fraudulently tendered will increase the capacity for carrying bona-fide passengers."

Statistics are then given of the number of transfers between the New York City system and the Third Avenue system, which amounts approximately to 28 per cent of the entire number of transfers issued by the surface lines of Manhattan Island. It is believed that if the transfer privilege between these two systems is abrogated, the opportunity for the fraudulent use of these transfers will be proportionately curtailed.

The petition of the receiver of the Third Avenue Railroad Company also points out the importance of reducing the number of transfers. He states his belief that there is no legal obligation upon him as receiver of the Third Avenue Company to continue transfers with any of the Metropolitan lines and he is of the opinion that it is highly unprofitable for the Third Avenue Railroad to continue such an exchange of transfers. The same is true as regards the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway Company, but with the Dry Dock, East Broadway & Battery Railroad Company, of which it is receiver, there are so many contracts with respect to the use of tracks jointly with other roads that he does not deem it at present desirable to undertake any action in respect to the transfers now exchanged between that and other railroads. He desires, however, to continue to exchange transfers between the Third Avenue Railroad and the Forty-second Street and other railroads controlled by it, in order to assist in building up a system of roads better fitted to compete with the Metropolitan system.

The memorandum submitted by the receiver of the Third Avenue Railroad Company declares that for 10 cents it is practically possible for anyone to buy a free pass for one day over all of the street railways in New York City. As an example he submits the experience of one man who, upon payment of one 5-cent fare, traveled on 12 cars east, west and south, stopping to get lunch, buy theater tickets and to do other errands until he reached the tunnel to Hoboken. On returning from that city he paid one more 5-cent fare to get a northbound transfer, and as he still had his south-bound transfer he traveled over the city in all directions using this time 18 cars. At twelve o'clock that night he still had a transfer good for north riding and another for south riding.

The petition of the receiver of the Third Avenue Railroad Company further points out that the issuing and taking in of transfers is a great burden upon the conductors and makes them less efficient in collecting fares and preventing accidents; that the condition produced by the transfers has now become unendurable and that it is necessary for the press and the public generally to recognize the fact that it is ruination to the company, a temptation to the employees and demoralizing to the public itself.

Judge Lacombe, in passing upon the petition states that as a business proposition the curtailment of transfer privileges is an obvious duty upon the receivers. Section 104 of the railroad law of the State, however, requires their issue when a continuous ride is taken over the line of one company. It also seems to require a company which operates a section of track over 1000 ft. long jointly with another company to issue transfers to all cars which are there operated, so that a passenger can ride continuously to his destination on either road. The decisions of the courts construing these statutes, however, are somewhat conflicting, although touching the particular problems raised by the application of the receivers no difficulties are presented. As a result, Judge Lacombe gives the receivers permission to discontinue certain of the transfers now issued between the two companies as follows: All of the transfers between the Third Avenue system proper and the Metropolitan system can be discontinued. Transfers should be continued between the Forty-second Street, Manhattanville & St. Nicholas Avenue Company and the Metropolitan system on the Boulevard between Sixty-fifth Street and Seventy-second

Street; on First Avenue between Thirty-fourth Street and Forty-second Street, and on Tenth Avenue between Forty-second Street and Fifty-ninth Street. At other points they can be discontinued. No change is recommended for the Dry Dock system at present.

Judge Lacombe states, however, that none of the changes permitted shall take place until April 11, 1908, and that one week's notice about them must be posted in all cars operating within the affected territory.

THE CLEVELAND SITUATION

The principal feature of the negotiations between Mayor Johnson and F. H. Goff last week was the decision to relay the tracks on Central Avenue and Quincy Street and the organization of a company known as the Neutral Railway Company, to do the work. A. B. DuPont and Mr. Goff compose this company so far as furnishing the money to do the work is concerned, while A. B. DuPont holds the position of president. Owing to the demand for service on that route, it is deemed necessary by these gentlemen to have the tracks relayed as soon as possible. The Cleveland Electric was asked, in the first place, to furnish the money for the work, but later on it was thought best to secure funds from other sources, although President Andrews had made arrangements to do so under certain conditions. Mr. Goff made the proposition to the Mayor that they secure the funds and have the work done. George Mulhern, formerly general manager of the Cleveland Electric Railway, was selected to take charge of the construction and Friday morning began work with a large gang of men. It is believed that these tracks will be in shape for operation within a month. Both companies will have the right to operate over them, temporarily, at least.

President Andrews, of the Cleveland Electric, offered to build the tracks on Quincy Street if assured of a franchise until 1910. This the Mayor would not promise. When the lines are completed they will be rented to the operating companies at a nominal figure. The plan of having the city construct the tracks will therefore be done away with.

A large part of the time the past week has been given up to the preparation of a lease to the old company. Up to Friday several important points had not been decided. One of them relates to the amount of money necessary for maintenance and sinking fund, and another the extent of free territory, but it is said that Mr. Goff has practically agreed that a large section in the down-town district, including a part of the West Side, shall be free to other companies. He protested vigorously against this for some time, saying that it would lay the holding company open to competition and probably result in trouble later. Mayor Johnson argued that if the free territory provision was not liberal both he and Mr. Goff would be criticised later for not including it in the lease. He said that the streets would be tied up for a term of years and that people would look upon it as they do exclusive franchises to corporations at the present time. The question of fare in the security franchise has also been the subject of much discussion. Mayor Johnson wishes to make it seven tickets for a quarter, while Mr. Goff insisted that the proposition would be a much stronger one financially if the rate were made six tickets for a quarter. The security ordinance in effect renews the franchise of the old company for twenty-five years, on the surrender of the present franchise and makes a cash fare of five cents, with ticket fare undecided. It is required, where new streets are improved, that the company shall pave seven feet in width for single track and sixteen for double track. In other cases the company must keep the pavement in repair and repave when other portions of the street are repaved, the strips of the same width as in the case of new improvements. This requirement Mr. Goff has consistently opposed as being too stringent.

Mail, package, funeral, observation, express, passenger and other special cars may be operated at rates to be fixed from time to time.

It is provided that the city may purchase the property at the expiration of the franchise at a price to be fixed by a board of arbitration. If the city should not desire to purchase and the franchise is not renewed, a grant may be made to any person who shall take the property, under the conditions laid down for the purchase by the city. A rental of $3,000 a year shall be paid for the use of the viaduct tracks and this sum may be readjusted at any time, provided the rental does not exceed 6 per cent on the original cost. The company is to operate under the general railway ordinance now in force and as modified by the City Council. At the close of the meeting Friday the Mayor and Mr. Goff were still far apart on the price of the stock.

Mr. Goff has made the assertion that he and the Mayor will either come to some conclusion or disagree this week. A 50-year lease, with a renewal provision, will probably be decided upon. Mr. Goff seems to be willing for this, as is the Mayor.

TEMPORARY LOCATIONS IN MASSACHUSETTS

The enactment of a law this month to enable the local boards and the Railroad Commissioners to grant "temporary" locations for street railways has given a new turn to the Boston Elevated Railway proposal to lay tracks in Newbury and Hereford Streets, for avoiding railroad bridges in Boylston Street and Massachusetts Avenue pending the reconstruction of these bridges. The location on a permanent basis had been passed by the Aldermen and heard by the Railroad Commission before the "temporary" law was enacted. Thirty days' delay is understood to be requisite before proceedings can be started under the new law, and the "L" was desirous of beginning work as soon as possible. It was held that some understanding could be arrived at whereby the location, though granted under the "permanent" law, might be restricted to temporary use. Counsel for the company claimed that no "temporary" location could be legally granted under the old law. But the report of the commission for 1900 (page 122) gives the record of such a "temporary" location, granted to the Commonwealth Avenue Street Railway as a means of allowing it to take a roundabout course in extending its tracks in Centre Street, Newton, across the tracks of the Boston & Albany Railroad, pending the construction of a bridge at the point where it originally desired to cross the railroad. This "temporary" location was used until last year, when the more direct route was built on, and the "temporary" location abandoned and cleared of its tracks. Disregarding this, objectors to the Newbury Street grant have begun an effort in the Board of Aldermen to have the location order rescinded and the matter thereby recalled from the Railroad Commission, inviting the Elevated Company to begin proceedings afresh, under the new "temporary" law.

THE NEW ENGLAND STREET RAILWAY CLUB BANQUET

The annual meeting and banquet of the New England Street Railway Club was held at the Hotel Somerset, Boston, on March 26. All the former officers were elected for the ensuing year. The official ticket, published on page 471 of the Street Railway Journal for March 21, received a unanimous vote. The dinner in the evening was attended by about 350 members and their guests and was one of the most successful undertaken by the club. President-elect Brush presided and Charles C. Peirce, of the General Electric Company, acted as toastmaster. Among the guests at the head table were: Maj.-Gen. William A. Bancroft, C. S. Sergeant, Calvert Townley, Horace B. Rogers, D. A. Belden, B. V. Swenson, L. S. Storrs, E. G. Connette, A. B. Smith, C. Loomis Allen, Edward F. Peck, H. R. Goshorn, H. E. Farrington, J. H. Neal, Paul Winsor, D. M. Brady and Henry C. Page. The speakers were: Hon. Samuel L. Powers, of Boston; Hon. James F. Shaw, first vice-president American Street & Interurban Railway Association; Hon. T. E. Byrnes, vice-president New York, New Haven & Hartford Railroad, and Hon. George A. Post, president Standard Coupler Company, of New York.

Mr. Shaw's speech was devoted largely to a discussion of the arduous conditions under which transportation enterprises in Massachusetts at present are laboring. He said that legislation to attract capital was badly needed. Now capitalists are looking for other channels in which to invest their money. Mr. Shaw also referred to the work being accomplished by the American Street & Interurban Railway Association, which he said deserved the support of all electric railway companies, and of all individuals interested in the electric railway industry.

Mr. Byrnes also advocated an improvement of conditions. In several cities where he had lived in the West all the people were "boosters"; in New England the tendency was often to be a "knocker." Mr. Post discussed the demands made by all sorts of people, nominally in the interests of the public. His own opinion was that the people had no sympathy with these doctrinaires and wanted more than anything else to be given a rest. Music was dispensed throughout the evening by a regimental band.

IMPORTANT IMPROVEMENTS IN BROOKLYN

The report published in the last issue of this paper to the effect that J. P. Morgan & Company, of New York, as a result of an expert investigation of the physical property of the Brooklyn Rapid Transit Company, had arranged to act as its financial agents appears to be confirmed by the events of the past week, although neither the railroad nor the banking house has seen fit formally to state the nature of the relations between them. Presumably this is because the plans are not yet sufficiently advanced to make it advisable to announce them. It has been known for some time that the present management of the company, having rehabilitated the property, was anxious to carry out a number of pretentious projects in order more fully to meet the obligations imposed by the large increase in population in the outlying sections of Brooklyn, and also to secure suitable terminals in Manhattan. One of these, which has been broached from time to time, is the third tracking of certain elevated lines. This and many other improvements, it is now said, will be provided for by a loan of some $40,000,000 to $60,000,000, to be made through Morgan & Company. The Brooklyn *Eagle* is authority for these statements. That paper does not claim the authority of the Brooklyn Rapid Transit Company or of Morgan & Company, but some of the statements it makes are known to be well in accord with certain policies for the future that have been shaping themselves for some time.

According to the Brooklyn paper, much of the promised development depends upon the terminal facilities given the company in Manhattan. Rights of way over the Williamsburg, Manhattan and Brooklyn bridges are conditioned as well as the "buttoning together," by loop, of these bridges. While the Brooklyn Rapid Transit Company has until recently refused to consider the question of operating the subway loop, the new arrangement, it is said, makes it possible for the company seriously to consider the proposition of operating this underground loop, and also the subway extension to the North River from the Williamsburg and Manhattan bridges, which the Public Service Commission is planning. In this connection, however, the opinion is advanced that since these extensions from the two new bridges would almost meet at the North River, they should by all means be connected so as to make a loop permitting a continuous service of trains and trolleys, thus establishing a most efficient cross-town Manhattan service, as well as a wide distributing area from the Brooklyn elevated system.

Should such terminal arrangements be effected in Manhattan it is stated that the Brooklyn Rapid Transit Company would not be adverse to considering a plan to operate trunk line subways under the heart of downtown Brooklyn, connecting with its elevated system at feasible points. It is even hinted by the *Eagle* that the company may consider the proposition to be a party to the operation of the Fourth Avenue subway as far as Thirty-ninth Street, where it would articulate with its West End, Sea Beach, Culver and Bay Ridge lines radiating at that point. Beyond that point very important improvements are said to be planned. It is contemplated to elevate the Culver, West End and Sea Beach lines, now operating on the surface, from Thirty-sixth Street to Coney Island. With regard to New Utrecht Avenue from Thirty-ninth Street to Sixty-second Street, where the Sea Beach and Bath Beach trains diverge, arrangements will be made with the Public Service Commission and the city that will result in the depression of the tracks, it is said.

At the Coney Island end of the Sea Beach and Bath Beach lines a big union terminal is planned. A definite decision is also reported to have been reached to change the Coney Island approach of the Sea Beach line, diverting it over the private property lately acquired by the company into a terminal with the West End division. This great double terminal will either be established on the site of the present West End terminal or a few blocks farther west opposite the main entrance to Steeplechase Park. The latter location is now being considered.

Other plans of the company are said to include the four tracking of the Fulton Street Elevated line to Franklin Avenue and the Brighton Beach line to Church Avenue, connecting with the present four-track system to Coney Island, the third tracking of the Broadway Elevated line to East New York, the third tracking of the Fifth Avenue and Myrtle Avenue lines, and an elevated structure over Flatbush Avenue extension, connecting the Fifth Avenue and Fulton Street lines with the Manhattan Bridge. An alternate plan to this line over Flatbush Avenue extension is a double deck six-track elevated structure through Hudson Avenue to about Nassau Street, thence connecting with the Manhattan Bridge and possibly continuing to the Brooklyn Bridge, making a fine bridge loop on the Brooklyn side which would greatly facilitate local traffic.

That the excellent record of the present management of the Brooklyn Rapid Transit Company is appreciated is fully instanced by the following editorial from the local press, which was decidedly antagonistic when Mr. Winter entered upon his duties: "Edwin W. Winter, as president of the Brooklyn Rapid Transit Company, has always realized his duty to the public, as well as to his stockholders, and he has done his best to furnish to the people of Brooklyn as convenient and comfortable a transportation system as has been possible in existing physical and financial conditions. He has done much, while he has been at the head of the system, to remove the natural and largely justified prejudice which was once felt. That the system has been put in excellent shape both from a transportation point of view and as a source of assured future profit is clearly indicated by this announced connection of J. P. Morgan & Company with the Brooklyn Rapid Transit Company. No more difficult task was ever set before a traction manager and the recent announcement shows it to have been successful."

AFFAIRS IN NEW YORK

The advertisements for bids for the construction of the Fourth Avenue Subway in Brooklyn will be put out this week. The Travis-Lee bills, in which the Public Service Commission is very much interested, will also be taken up by the Cities Committee of the Senate. These are the bills which provide for an amendment of the Constitution exempting bonds issued by the city for rapid transit purposes from consideration of the debt limit, as long as the properties obtained shall provide a revenue sufficient to pay the interest on the bonds and a sinking fund for their redemption. If the bills are passed by the present Legislature they will be presented for passage again next year. If they pass two successive sessions of the Legislature they will be submitted to a popular vote, and, if approved by the public, will form an amendment to the State Constitution.

Judge Lacombe, in the United States Circuit Court, has authorized Adrien H. Joline and Douglas Robinson, two of the receivers of the Metropolitan and New York City Street Railway Companies, to issue certificates for $3,500,000 for one year at 6 per cent, superior to the two mortgages, for improvement.

The proposal of the Interborough Rapid Transit Company to execute a mortgage for $55,000,000 on its property against which bonds are to be issued, has been approved at the special meeting of the stockholders. The trustee under the Interborough-Metropolitan bonds, against which $33,912,800 of interborough Rapid Transit Company's total $35,000,000 capital stock is held, voted in favor of the proposed issue. The Public Service Commission has not yet given its consent to this financing on the part of the Interborough, although it is believed such consent will be given after the commission reviews the matter in the hearings to be held. It is the intention of the Interborough Rapid Transit Company, providing the plan as outlined is finally carried out, to issue in the immediate future $18,000,000 bonds to refund or extend the $15,000,000 4 per cent notes maturing May 1 next, and $12,000,000 to discharge other outstanding indebtedness of $10,352,726. If it is found difficult to find a market for the bonds, short-time notes may be put out with the bonds as security.

The Interborough-Metropolitan Company is now in default on three quarterly dividend payments on its 5 per cent cumulative preferred stock, the dividend due to be declared March 5 and to be paid April 1 not having been met. The dividend was first passed Sept. 5 and again Dec. 5 of last year. As there is $45,740,000 of this preferred stock outstanding the amount of the default now totals $1,715,250. There appears to be no immediate prospect of the preferred dividend being resumed.

The Brooklyn Rapid Transit Company announces that the departments of employment and inspection, which have been merged for some years, are to be separated. Frank Cooley, the superintendent of the consolidated departments, will have charge of the inspection service, reporting to the vice-president and general manager. J. T. Crabbs will have charge of the employment department, reporting to the superintendent of transportation.

PUBLIC SERVICE EARNINGS—PAY-AS-YOU-ENTER CARS SOON

The board of directors of the Public Service Corporation last week declared a 1 per cent dividend for the quarter ended March 31. Reports received from the traffic department show an increase of about 7 per cent in passenger traffic for January and February over the corresponding months of last year. The total car mileage during these two months aggregate 6,377,704 miles, as against 5,792,821 for the same period of last year, making an increase of 584,883 miles or a net daily increase of 9748. It was also reported that the passenger traffic showed an increase of 2,500,000 passengers over the same period of last year. R. E. Danforth, general manager of the transportation department, explained that this increase in the number of passengers carried represented a large percentage of non-revenue traffic, including transfer fares and employees. He could not state definitely when pay-as-you-enter cars would be in operation, but thought the Broad Street line would be equipped by April 15. He explained that it would take at least fifty cars to equip this line, while at present only twenty-six cars have been received. Of the cars now on hand only ten are ready. After the Broad Street line, Mr. Danforth said, other lines will be equipped. It is expected that by June 1 the 150 cars ordered will be in service. If the pay-as-you-enter cars prove successful it is said the company will order 600 of them. While the McAdoo tunnels have been responsible for a large increase in traffic on the Hoboken lines, the increase is said to represent a divergence of from 5,000 to 6,000 passengers a day from the Jersey City lines to those at Hoboken.

RAIL CONTROVERSY IN COLUMBUS RESULTS IN SERIOUS CONFLICT

Early last Wednesday morning the city officials at Columbus, Ohio, tore up a large section of the track of the Ohio Electric Railway Company on Mound Street, in an effort to force the company to lay grooved rails, upon which the city has been insisting for some time. About one hundred workmen were ordered to the scene at 6 o'clock in the morning and by 9 o'clock about three hundred feet of track had been torn out. Shortly before noon a temporary restraining order was secured from Judge Charles M. Rogers to prevent the city from interfering with the relaying of the tracks and in the afternoon 300 men were put to work, with the result that traffic was resumed in the evening. City Solicitor George S. Marshall, City Engineer Maetzel and members of the board of public service were in immediate charge of the work of tearing out the tracks.

Mr. Marshall states that he took this action in order to force the matter into the courts, as the company had been notified that this street would be improved with a pavement and that the T-rails should be replaced by grooved, in accordance with an ordinance passed by the City Council on June 10 of last year. The general ordinance granting the company a franchise on this street also provided that it shall pave between its tracks and one foot on the outside with the same material used by the city in its pavement.

Mr. Marshall had prepared a suit to be filed, asking that the company be enjoined from interfering with the improvements of the street, but Judge Rogers decided that the company should be given the right to continue operations pending a court decision on the question of rails. The petition of the railway company states that it laid T-rails at a cost $25,000, that they are in good condition and suited to the needs of interurban cars and that to lay grooved rails would mean an additional expense of $75,000 which the company feels is needless.

Vice-President and General Manager Crawford of the Ohio Electric Railway Company states that the action of the city officials in tearing up the tracks is an outrage. He says the company's position has been continuously misrepresented to the people of the city. If there has been a delay in the improvement of the streets, he says the City Solicitor is responsible. Mr. Crawford states that the company's franchise requires that when the city improves the street, it shall improve the part between the rails and a foot outside at the same time and in the same manner. The city officials had been advised that the company was ready to carry this out to the letter. While the city made a contract to pave its part of the street long ago, work has never been commenced and no material of any kind is on the ground for the purpose. As to the type of rail, Mr. Crawford says that the company denies the right of the city to require it to tear up its existing tracks and replace them with an entirely different method of construction. This, he says, is a legal question to be decided by the courts and that the company has been willing to co-operate with the City Solicitor in bringing a test suit that would quickly settle it. Both in writing and orally this proposition was made nearly a year ago, but this official is said to have refused.

CITY OF WINNIPEG BUYS ELECTRIC RAILWAY & LIGHT PROPERTIES

Arrangements were made March 30 for the purchase by the city of Winnipeg of the entire holdings of the Winnipeg Electric Company, estimated to be worth in the neighborhood of $15,000,000. For some weeks negotiations have been in progress, but it was not until March 30 that the company decided to dispose of the property, Winnipeg buying at the closing prices in Toronto on even date. The company also has a franchise for supplying gas. The street railway franchise was an exclusive one. The city already owns the waterworks, stone quarries and an asphalt plant. The provincial government owns the telephone system.

MacGOVERN, ARCHER & COMPANY

A new firm, under the name of MacGovern, Archer & Company, succeeding Rossiter, MacGovern & Company, has been organized in New York. It will continue the buying and selling of electrical and steam machinery, as carried on for the past 12 years by its predecessor.

Mr. MacGovern needs no introduction in the railway and lighting field. He entered electrical work when barely twenty-three years of age, and at once organized the firm of Rossiter, MacGovern & Company. At that time the business of buying and selling electrical machinery was in its infancy. Mr. MacGovern was quick to see the possibilities offered by reason of the number of consolidations that were being effected in both the street railway and the lighting field, which were displacing a large amount of first-class machinery. The result was that he rapidly built up the business of Rossiter, MacGovern & Company to large proportions. Two years ago the firm of Rossiter, MacGovern & Company was reorganized, and new interests taken in with a view of extending operations into the contracting and construction field. This branch of the business unfortunately was not successful, and it was deemed best for all the parties interested to apply for a receivership. Mr. Archer, who is associated with Mr. MacGovern, is well known in the street railway and lighting circles, having been with Rossiter, MacGovern & Company as sales manager for about six years.

The new firm will adhere strictly to the handling of high-grade electrical and steam machinery. Mr. MacGovern's friends will undoubtedly wish the new firm every success, and those who are best acquainted with his capabilities have no doubt but that it will be of an emphatic character.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED MARCH 17, 1908.

881,938. Block Signal; Don D. Miles, Jr., Aurora, Ill. App. filed Nov. 10, 1906. A block system for surface roads having an overhead trolley. Includes a special form of contact shoe suspended above the trolley wire between a pair of adjacent hangers and which closes a plurality of circuits in predetermined order.

881,949. Truck Bolster Hanger; William G. Price, New Castle, Pa. App. filed Aug. 20, 1906. The pivotal joints of the bolster hangers comprise pins and eyes constructed to contract on a line only, the eyes being wider than the pins, thereby producing a rocking movement one on the other.

882,024. Switch Stand; Fred W. Snow, Hillburn, and William C. Kidd, Suffern, New York, N. Y. App. filed Dec. 20, 1907. Means to control the automatic throwing of the switch, manually operated means to throw the switch normally in engagement with the automatic means, and means to disengage

the manually operated means from the automatic means and throw the switch in a single operation.

882,050. Rail Fastening for Concrete Railway Ties; Henry H. Clough, Elyria, O. App. filed Sept. 4, 1906. Metallic sleeves are moulded into the tie, said sleeves having means for engaging the heads of rail securing bolts.

822,063. Fare Register Operating Mechanism; William H. Honess, Hartford, Conn. App. filed April 13, 1906. This device serves to translate or convert the operating movements received from diverse directions into the particular uniform movement required to actuate the registering or counting mechanism.

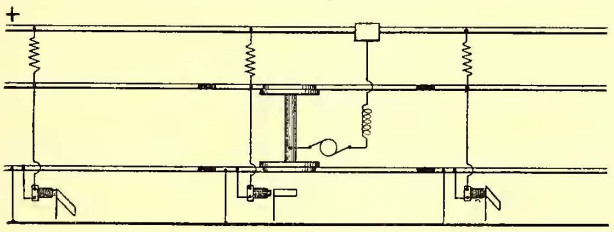
822,089. Electric Signaling Apparatus; Benjamin F. Wooding, Denver, Colo. App. filed Jan. 4, 1907. A signaling system for railways including among other features a folding contact device mounted upon the train and having sufficient range of movement to compensate for the swaying movement of the train and also for the difference in height of the signal conductors.

882,107.—Brake Shoe; William B. Goodwin, Columbus, O. App. filed June 17, 1907. A steel shell adapted to be filled with a composition of matter to form a braking surface, said shell being removably attached to a back member.

882,108. Brake-Beam Hanger; William Hamilton, Erie, Pa. App. filed Oct. 11, 1907. The hanger comprises, in part, a preferably rolled metal section which ties together the top arch bars of a truck and which may serve also to lock the column bolts.

882,139. Restoring Attachment to Trolley Wheels and Electric Signal for the Same; George H. Brooks, Louisville, Ky. App. filed June 17, 1907. A spool-shaped roller is mounted in a yoke pivoted to the trolley pole. A pull on the trolley cord moves the roller to a position to aid in replacing the trolley wheel on the wire.

882,143. Block Signal System; William Daves, Bloomington, Ill. App. filed Dec. 23, 1907. Comprises a signal lever and lock therefor, a magnet for actuating the lock, means associated with the lock for completing a maintaining circuit for the magnet and an actuating circuit for the magnet.



PAT. NO. 882,523

882,157. Safety Appliance for Railway Trains; Robley V. Millard, Atlanta, Ga. App. filed July 17, 1907. The main line of pipe connecting the several cars of a train and normally containing air under pressure for controlling the brake apparatus, is provided with an electrically controlled valve which is actuated to vent the main pipe and admit of a setting of the brakes, said valve under normal conditions being closed, to admit of the brakes being inactive or held out of operation.

882,200. Railway Joint Chair; Calaway Herndon, Wagoner, Oklahoma. App. filed Sept. 16, 1907. An integral sleeve for the reception of the rail ends.

882,275. Railway Signaling Apparatus; John D. Taylor, Edgewood Park, Pa. App. filed Jan. 4, 1908. Relates more particularly to roads using alternating-current propulsion and using one of the track rails for the purpose of carrying the signaling current, while the other rail is used for carrying both the propulsion current and the signaling current. Provides means which will generate a counter-electromotive force which will oppose the fall of potential and will prevent the propulsion current from flowing through the relay and track transformer.

882,276. Electric Signaling System; John D. Taylor, Edgewood Park, Pa. App. filed Jan. 30, 1908. Relates to modifications of the above.

882,450. Trolley; Frank E. Brazeal, Monson, Mass. App. filed June 15, 1907. The trolley wheel has a pair of annular chambers with oil therein for lubricating purposes.

882,495. Trolley Car Pole Attachment; George R. Dunn, San Diego, Cal. App. filed Aug. 30, 1906. The trolley harp is pivoted to the pole on an inclined axis in the plane of the trolley wheel. The wheel is held in comparatively rigid relation by a chain connection, and is capable of slight lateral movement through the resiliency of the chain.

882,523. Block Signal System; Frank E. Kinsman, Plainfield, N. J. App. filed Nov. 29, 1904. The track rails are sectionally divided for signaling circuit purposes, and the power conductors are arranged in a special way so as to be separated by a considerable distance whereby the danger to persons walking on the track is minimized.

PERSONAL MENTION

MR. J. W. McDONALD has been elected president of the Lincoln Traction Company, to succeed Mr. M. L. Scudder, of New York.

MR. MELVILLE DOZIER, JR., who for the past year and a half has been president and chief engineer of the Vallejo & Northern Railway Company, has severed his connection with that corporation to engage in railway work elsewhere in the state.

MR. W. E. DODDS, head of the steam-engine department of the Allis-Chalmers Works at Milwaukee, has resigned. Mr. Dodds has been connected with the company for many years and was formerly the assistant of Mr. Edwin Reynolds of the E. P. Allis Company.

MR. WILLIAM CRILLEY, who has been acting as superintendent of the Hartford & Rockville Line of the Connecticut Company, with offices in Rockville, has been recalled to Hartford and the management of the Rockville line placed under the direction of Division Superintendent Nettleton, of Hartford.

MR. E. W. HENDERSHOT, of Montreal, has been appointed comptroller of the Illinois Traction System, and the Western Railway & Light Company, which controls properties in northern Illinois. Mr. Hendershot will represent Canadian banking and insurance interests which have been largely instrumental in financing the Illinois properties. He will have his headquarters at Champaign, Ill.

MR. G. C. PIERCE, general superintendent of the East St. Louis & Suburban Railway, has resigned on account of failing health, and will leave soon on a pleasure trip through the West. He is succeeded by Mr. C. F. Hewitt, general superintendent of the St. Joseph (Mo.) Railway, Light, Heat & Power Company, which is controlled by the same interests as the East St. Louis & Suburban Railway.

MR. E. N. SAWTELLE, who has for some years been the London district manager of the British Westinghouse Electric & Manufacturing Company, has been recently appointed territorial sales manager, with headquarters at Manchester. Mr. Sawtelle was for many years connected with the Westinghouse interests in Cleveland and New York. Mr. O. H. Baldwin, who is also well known in the United States, but better known in England for the past 10 or 15 years, has been appointed the manager of the London district.

MR. E. C. BOYNTON, general manager of the Orange County Traction Company, has resigned from that position, his resignation dating from April 1. Mr. Boynton is the author, with Mr. Albert B. Herrick, of "American Electric Railway Practice," and has been connected with the New York, New Haven & Hartford Railroad Company, the National Brake & Electric Company and other well-known corporations. He is planning to take a short vacation before engaging again in active work.

MR. GEORGE O'CONNOR, for several years traveling freight and passenger agent for the W. & C. R., has resigned to become assistant traffic manager of the Walla Walla Valley Traction Company, vice Frank Root, who is to become manager of the Roslyn Coal Company. Mr. R. E. Allen, manager of the traction company, will resign his position shortly to engage in private business. Mr. Allen's successor has not yet been announced, but it is rumored that he will be succeeded by Mr. F. J. MacGougan, for several years manager of the Walla Walla office of the Pacific States Telephone Company.

MR. A. L. NEEREAMER, formerly superintendent of the Columbus, Delaware & Marion Railway Company, as noted elsewhere in this issue, has been chosen chairman of the Central Electric Traffic Association, organized at the Dayton meeting of the Central Electric Railway Association two months ago. He will remove from Delaware to Indianapolis within a short time to take charge of the work. The position involves traffic supervision of the roads within the territory covered by the Central Electric Railway Association, much the same as the traffic associations of the steam lines, and is one for which Mr. Neereamer is well fitted.

MR. FRANK A. BURKHARDT has been appointed assistant general passenger and freight agent of all divisions of the Ohio Electric Railway Company. He will have his headquarters in Lima and Dayton. Mr. Burkhardt was formerly division passenger and freight agent of the Lima-Ft. Wayne, Lima-Toledo and Lima-Defiance divisions. He was promoted on account of the resignation of Mr. W. O. Woodard, division passenger and freight agent at Dayton, and Mr. J. O. Larason, division passenger and freight agent at Springfield, whose offices have been abolished. Mr. Burkhardt came to the Ohio Electric Railway Company from the Cincinnati, Hamilton & Dayton Railway Company.

MR. CHARLES HALLAM KEEP, who was appointed a member of the Public Service Commission of the Second District of New York last June by Governor Hughes, has resigned from the commission to become president of the Knickerbocker Trust Company, of New York. Mr. Keep is a graduate of Harvard University, class of '82, and of the Harvard Law School. After being admitted to the bar of New York State, in Erie County, he practised law in the city of Buffalo. In 1903 he was appointed Assistant Secretary of the Treasury, where he remained until January, 1907, when he was appointed Superintendent of the Banking Department of the State of New York by Governor Hughes.

MR. WILLIAM ORMISTON CALLENDER, the founder of Callender's Cable & Construction Company, Ltd., one of the large English manufacturers of wires and cables, died at his residence in Bournemouth, England, on March 14. Mr. Callender was born in Leith in 1827, and was consequently 81 years of age at the time of his death. He settled in London in 1866, and shortly thereafter became connected with the paving industry. In 1879 he patented an insulating material in which Trinidad bitumen formed the chief ingredient, and this material has become widely known as a dielectric for underground mains, under the name of "vulcanized bitumen." The Callender's Bitumen Telegraph & Waterproof Company was founded in 1882 to develop this invention, and the present company, Callender's Cable & Construction Company, Ltd., is its successor. It will be remembered also that Mr. Callender organized an American company about 1884, but it had only a short-lived career.

MR. ARTHUR B. SMITH, who has held the position of traffic manager of the Consolidated Railway Company, which controls the electric railways operated by the New York, New Haven & Hartford Railroad, has been appointed general passenger agent of the New York, New Haven & Hartford Railroad, with headquarters in Boston, and jurisdiction over the entire passenger service of the New Haven Company, including the New England Navigation Company. Through Mr. Smith's appointment, which took effect April 1, Mr. George L. Connor, passenger traffic manager, and Mr. A. C. Kendall, general passenger agent of the New Haven Company, are retired on pensions. Their former offices will be consolidated in that to be held by Mr. Smith. Mr. Smith was born in Boston and was educated in New England. For twenty-one years he was connected with the Chicago, Burlington & Quincy Railroad at Omaha, Neb., nine years of which time he spent in the engineering and maintenance of way department and twelve years in the traffic department. In 1904 he became connected with the Yellowstone Park Association and a few months later he became assistant general passenger agent of the Northern Pacific Railroad at St. Paul. It was this position he resigned to become connected with the Consolidated Railway. It is understood at the Boston offices of the Consolidated Railway that no successor to Mr. Smith as traffic manager of the company has yet been appointed, and that his duties with reference to the electric railways will be taken care of without a special appointee, for the present. The appointment rests with the Connecticut Company.

MR. MATTHEW C. BRUSH, the newly elected president of the New England Street Railway Club, is a well-known street railway man, being vice-president and general manager of the Boston Suburban Electric Companies, with offices at Newtonville, Mass. Mr. Brush graduated from the Armour Institute, in Chicago, and the Massachusetts Institute of Technology, Boston. He has had a broad steam railroad and steamship experience, together with street railway experience for several years past. He was purser on the Great Lakes for five years; machinist, foreman, and round-house foreman, Union Pacific Railroad, at Omaha, Neb.; general foreman, in charge of shops and round houses, Chicago, Rock Island & Pacific Railroad, Kansas. Mr. Brush commenced his street railway work in 1903, when he was appointed assistant to the president, Boston Suburban Electric Companies. The following year he was made general manager of the Newton, Lexington & Natick Railway systems, and in 1905 was elected vice-president of the same properties. Mr. Brush has been very active in the New England Street Railway Club since he has been located in New England being on various committees of the organization, and in 1907 was elected vice-president. During the past two years he has been chairman of the committee of the Trolley Information Bureau, which has been conducted by the club for acquainting the public with the possibilities of electric railway transportation.

MATTHEW C. BRUSH.

MR. JOHN ALBERT BRILL, vice-president, director and one of the founders of The J. G. Brill Company, died on March 25, after patient suffering of four years from a painful malady. The following sketch of his life has been prepared by Mr. James Rawle, his life-long friend and associate:

JOHN A. BRILL

Mr. Brill was born in Philadelphia on Dec. 15, 1852, whither his parents had moved from Cassel, Germany, a few years before. Always studious as a lad, he received a sound education. At the early age of seventeen his instinct of industry led him into the works upon which he has since stamped his strong individuality and to whose building up he gave the absolute love and devotion of his life. Endowed with great ability, in which keen insight was united with infinite perseverance, he brought to the work of his life the qualities of an inventor of the most valuable improvements in transportation facilities. These embraced nearly every feature of cars and trucks which go to make up the modern electric car. At the outset of his career he did with his whole soul the things which a boy could do—drove the engine, kept the accounts. Gradually he was advanced by the firm to more responsible positions and was soon placed in charge of the department of sales. In this his great abilities found their appropriate sphere. When, in 1887, electric propulsion developed his genius developed with it, and the present types of electric trucks in universal use are practically those which he invented. He was in every sense of the word a pioneer. He led; others followed. He foresaw by instinct, and usually years in advance, the direction in which electric street railway practice must necessarily develop, and he devoted himself to the task of teaching the railway companies. Those high in their management recognized his wisdom and sound judgment and constantly sought his advice—sooner or later they always followed it. In 1904 the Franklin Institute awarded him the John Scott legacy premium and medal for meritorious inventions in cars. He had a strong sense of justice, but resented bitterly any treatment which he considered unfair. It is sad to see a man so strong, so worthy and so useful, stricken down by the lingering pain of disease.

TABLE OF OPERATING STATISTICS

Notice.—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement, "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years. Similar statistics in regard to roads not reporting are solicited by the editors. * Including taxes. † Deficit. ‡ Including Rapid Railway system, Sandwich, Windsor & Amherstburg Railway, and Detroit, Monroe & Toledo Short Line Railway.

Company.	Period.	Total Gross Earnings.	Operating Expenses.	Net Earnings.	Deductions From Income.	Net Income, Amount Available for Dividends.
AKRON, O. Northern Ohio Tr. & Light Co.	1m., Feb. '08	119,301	78,466	40,835	42,405	†1,570
	1 " " '07	116,858	72,711	44,148	41,400	2,747
	2 " " '08	245,427	160,358	85,068	84,907	162
	2 " " '07	242,049	152,292	89,758	82,739	7,017
BELLINGHAM, WASH. Whatcom Co. Ry.& Lt. Co.	1m., Jan. '08	32,538	*18,361	14,176	6,798	7,379
	1 " " '07	29,064	*15,975	13,089	6,214	6,874
	12 " " '08	357,943	*212,828	145,115	78,100	67,015
	12 " " '07	284,562	*184,516	100,046	50,546	49,500
CHAMPAIGN, ILL. Illinois Traction Co.	1m., Jan. '08	327,910	*193,654	134,256	.....	.....
	1 " " '07	279,078	*164,733	114,345	.....	.....
	1 " Feb. '08	304,538	*183,368	121,170	.....	.....
	1 " " '07	262,363	*147,204	115,159	.....	.....
	2 " " '08	632,448	*377 022	255,426	.....	.....
	2 " " '07	541,441	*311,937	229,503	.....	.....
CHARLESTON, S. C. Charleston Con.Ry., Gas & Elec. Co.	1m., Feb. '08	58,232	39,410	18,822	13,443	5,378
	1 " " '07	52,478	35,080	17,398	13,402	3,996
	12 " " '08	729,661	467,082	260,579	162,006	98,573
	12 " " '07	654,391	414,445	239,946	157,100	82,846
CHICAGO, ILL. Aurora, Elgin & Chicago Ry. Co.	1m., Feb. '08	85,552	54,825	30,727	28,605	2,122
	1 " " '07	86,940	53,809	33,131	27,131	6,000
	8 " " '08	962,760	527,479	435,281	221,201	214,079
	8 " " '07	876,639	473,808	402.832	210,318	192,514
CLEVELAND, O. Cleveland, Painesville & Eastern R.R. Co.	1m., Jan. '08	18,263	*10,802	7,461	7,213	248
	1 " " '07	18,032	*10,330	7,701	7,213	489
	1 " Feb. '08	15,917	*10,011	5,906	7,227	†1,321
	1 " " '07	15,456	*9,863	5,593	7,213	†1,619
	2 " " '08	34,180	*20,813	13,367	14,440	†1,073
	2 " " '07	33,488	*20,193	13,295	14,425	†1,131
Cleveland, S. W. & Columbus Ry. Co.	1m., Jan. '08	52,811	36,442	16,369	.....	.....
	1 " " '07	49,558	29,604	19,954	.....	.....
COLUMBUS, GA. Columbus Elec. Co.	1m., Jan. '08	30,432	*15,268	15,164	10,504	4,661
	1 " " '07	26,654	*14,036	12,618	9,381	3,238
	12 " " '08	344,353	*185,931	158,421	123,618	34,803
DALLAS, TEX. Dallas Elec. Corp'n.	1m., Jan. '08	89,616	*68,542	21,074	20,322	752
	1 " " '07	87,324	*71,165	16,159	16,550	†391
	12 " " '08	1,127,965	*815,479	312,486	226,880	85,607
	12 " " '07	1,032,132	*718,953	313,179	187,257	125,922
‡ Detroit United Ry. Co.	1m., Feb. '08	469,839	*332,046	137,793	135,122	2,671
	1 " " '07	470,925	*329,832	141,093	123,348	17,745
	2 " " '08	984,519	*671,519	313,000	271,168	41,832
	2 " " '07	985,924	*669,034	316,890	246,463	70,427
DULUTH, MINN. Duluth St. Ry. Co.	1m., Jan. '08	64,730	43,726	21,005	18,417	2,588
	1 " " '07	59,484	33,603	25,881	17,575	8,306
E. ST. LOUIS, ILL. East St. Louis & Suburban Co,	1m., Feb. '08	157,722	79,087	78,635	.....	.....
	1 " " '07	146,273	82,553	63,720	.....	.....
	2 " " '08	330,788	161,902	168,886	.....	.....
	2 " " '07	311,570	123,020	138,550	.....	.....
EL PASO, TEX. El Paso Cos.	1m., Jan. '08	46,802	*33,189	13,613	5,900	7,713
	1 " " '07	37,043	*28,702	8,341	4,469	3,873
	12 " " '08	516,453	*383,102	133,351	61,782	71,569
	12 " " '07	401,352	*285,352	116,000	47,935	68,065
FT. WORTH, TEX. Northern Texas Tr. Co.	1m., Jan. '08	74,202	*45,855	28,347	11,573	16,774
	1 " " '07	74,953	*46,096	28,857	10,138	18,718
	12 " " '08	1,060,203	*623,332	436,871	129,938	306,933
	12 " " '07	875,553	*556,862	318,691	119,778	198,913
GALVESTON, TEX. Galveston-Houston Elec. Co.	1m., Jan. '08	80,616	*55,084	25,531	13,886	11,645
	1 " " '07	75,641	*49,768	25,873	11,962	13,912
	12 " " '08	1,055,867	*661,512	394,355	155,952	238,403
	12 " " '07	919,701	*576,889	342,812	142,941	199,871
HOUGHTON, MICH. Houghton County St. Ry. Co.	1m., Jan. '08	18,678	*13,478	5,200	3,981	1,219
	1 " " '07	15,945	*15,637	307	3,959	†3,652
	12 " " '08	252,652	*153,758	98,894	47,471	51,423
	12 " " '07	230,358	*148,546	81,812	47,037	34,775
JACKSONVILLE, FLA. Jacksonville Elec. Co.	1m., Jan. '08	32,860	*23,384	9,475	5,427	4,049
	1 " " '07	31,727	*21,442	10,285	3,475	6,810
	12 " " '08	393,527	*258,284	135,243	52,117	83,125
	12 " " '07	333,282	*208,743	124,539	40,854	83,685
KANSAS CITY, MO. Kansas City Ry. & Lt. Co.	1m., Jan. '08	496,321	258,831	237,490	151,278	86,213
	1 " " '07	479,022	238.018	241,004	147,519	93,485
	8 " " '08	4,175,059	2,140,245	2,034,814	1,228,022	806,792
	8 " " '07	3,851,643	1,896,741	1,954,902	1,165,135	789,767
MILWAUKEE, WIS. Milwaukee Elec. Ry & Lt. Co.	1m., Feb. '08	300,434	173,173	127,261	95,978	31,283
	1 " " '07	283,927	150,234	133,693	90,466	43,227
	2 " " '08	615,142	353,818	261,324	194,087	67,237
	2 " " '07	593,435	313,313	280,122	184,516	95,606
Milwaukee Lt., Ht. & Tr. Co.	1m., Feb. '08	49,726	29,505	20,221	32,355	†12,134
	1 " " '07	48,675	25,235	23,440	26,656	†3,216
	2 " " '08	104,137	60,254	43,883	65,647	†21,764
	2 " " '07	102,211	53,060	49,151	54,054	†4,903
MINNEAPOLIS, MINN. Twin City R. T. Co.	1m., Jan. '08	469,891	258,201	211,690	121,956	89,735
	1 " " '07	456,837	243,097	213,740	115,258	98,482
MONTREAL, CAN. Montreal St. Ry.	1m., Feb. '08	270,224	201,449	68,775	46,207	22,569
	1 " " '07	243,468	182,275	61,193	36,493	24,699
	5 " " '08	1,458,463	943,476	514,987	220,025	294,962
	5 " " '07	1,327,460	888,196	439,365	195,667	243,598
PENSACOLA, FLA. Pensacola Elec. Co.	1m., Jan. '08	18,156	*12,756	5,400	3,619	1,781
	1 " " '07	17,308	*11,576	5,732	3,139	2,594
	12 " " '08	228,998	*153,061	75,936	41,384	34,552
PHILADELPHIA, American Rys. Co.	1m., Feb. '08	192,592	.....	.....	.....	.....
	1 " " '07	192,968	.....	.....	.....	.....
	8 " " '08	1,973,413	.....	.....	.....	.....
	8 " " '07	1,894,516	.....	.....	.....	.....
PLYMOUTH, MASS. Brockton & Plymouth St. Ry. Co.	1m., Jan. '08	6,587	*7,802	†1,216	1,873	†3,089
	1 " " '07	6,195	*5,835	361	1,732	†1,371
	12 " " '08	119,756	*89,673	30,084	21,520	8,564
	12 " " '07	112,234	*70,935	41,300	21,842	19,458
ST. LOUIS, MO. United Railways Co. of St. Louis.	1m., Feb. '08	775,454	*519,540	255,914	233,418	22,496
	1 " " '07	764,680	*548,479	216,201	231,325	†15,124
	2 " " '08	1,602,852	*1,073,899	528,953	466,872	62,081
	2 " " '07	1,591,017	*1,126,349	464,668	462,866	1,802
SAVANNAH, GA. Savannah Electric Co.	1m., Jan. '08	46,321	*40,566	5,755	12,568	†6,813
	1 " " '07	45,442	*30,613	14,830	11,687	3,142
	12 " " '08	603,279	*424,263	179,016	144,915	34,101
	12 " " '07	607,039	*377,796	229,244	135,244	94,000
SCHENECTADY, N.Y. Schenectady Ry. Co.	3m., Dec. '07	254.336	167,054	87,282	30,846	56,436
	3 " " '06	243,399	161,319	82,080	32,584	49,496
	12 " " '07	1,079,149	768,613	310,536	128,081	182,455
	12 " " '06	974,308	664,078	310,230	191,602	118,628
SEATTLE, WASH. Seattle Elec. Co.	1m., Jan. '08	364,203	*259,329	104,874	55,010	49,865
	1 " " '07	292,816	*200,781	92,035	42,134	49,902
	12 " " '08	4,176,181	*2,708,604	1,467,577	608,476	859,100
	12 " " '07	3,285,271	*1,954,947	1,330,324	492,972	837,353
SYRACUSE, N. Y. Syracuse R. T. Co.	1m., Feb. '08	99,110	61,246	37,864	28,573	9,556
	1 " " '07	90,424	51,608	38,816	25,100	13,770
	2 " " '08	201,532	128,463	73,069	57,030	16,680
	2 " " '07	187,549	105,255	82,294	49,719	32,684
TACOMA, WASH. Puget Sound Elec. Ry. Co.	1m., Jan. '08	122,978	*90,235	32,743	32,477	266
	1 " " '07	107,516	*82,520	24,996	24,650	346
	12 " " '08	1,679,744	*1,098,949	580,795	353,249	227,546
	12 " " '07	1,378,828	*928,280	450,548	276,957	173,591
TAMPA, FLA. Tampa Elec. Co.	1m., Jan. '08	45,294	*30,974	14,319	976	13,344
	1 " " '07	43,994	*31,153	12,841	960	11,881
	12 " " '08	522,480	*387,951	134,529	6,546	127,983
	12 " " '07	475,377	*290,701	184,675	2,383	182,292
TOLEDO, O. Toledo Rys. & Lt. Co.	1m., Feb. '08	208,698	116,301	92,397	68,449	23,948
	1 " " '07	200,778	119,159	81,619	63,154	18,465
	2 " " '08	426,437	241,389	185,048	137,053	47,995
	2 " " '07	422,587	249,487	173,100	125,462	47,638

NEWS OF THE WEEK

CONSTRUCTION NOTES

Items in this department are classified geographically by States, with an alphabetical arrangement of cities under each State heading.

For the convenience of readers seeking information on particular subjects, the character of the individual item is indicated as follows:

* Proposed roads not previously reported.
o Additional information regarding new roads.
† Extensions and new equipment for operating roads.

Numerals preceding these signs indicate items referring to:

1. Track and roadway.
2. Cars, trucks and rolling stock equipment.
3. Power stations and substations.
4. Car houses and repair shops.
5. Parks and amusement attractions.

1†PINE BLUFF, ARK.—The Citizens' Light & Transit Company, it is reported, has started the work of double tracking West Sixth Avenue. The additions are being made to the car line to enable the company to furnish quicker car service to Forest Park, Pine Bluff's summer amusement place. The theater is being remodeled and renovated and other improvements made.

1†LOS ANGELES, CAL.—The Los Angeles Railway Company has been awarded the franchises for the South Park Avenue line from Thirtieth Street to Slauson Avenue. The company paid $500 for the franchise.

oLOS ANGELES, CAL.—The permanent organization of the Los Angeles-San Francisco Short Line Electric Railroad has been completed and work on the new line which is to save 80 miles in distance and three hours in time has been decided upon. The route has been changed to take in Bakersfield. The road will branch at the exit from the Tejon Pass through the Tehachepi Mountains, the main line running to Bakersfield and the other continuing in a straight line up the San Joaquin Valley as a cut-off for the through freight and express trains besides tapping the rich oil districts of Sunset and McKittrick. The Westinghouse Manufacturing Company has submitted to Capt. Cross, president of the new road, plans for an electric locomotive. According to these plans the engine will weigh 170 tons and be capable of hauling the heaviest train now operated by the Southern Pacific. The permanent officers of the new road are: Capt. John Cross, president and general manager; Walter F. Haas, vice-president and chief counsel; Charles Wier, treasurer; Charles S. Burnell, secretary; M. K. Miller, chief resident engineer, all of whom with A. P. Cross, M. H. French, W. R. Ireland and John E. Loomis form the board of directors. It is hoped to have the road in operation within the next three years. The present capital stock of the company is $2,000,000. The incorporation of this company was mentioned in the last issue of the Street Railway Journal.

oRICHMOND, CAL.—The trustees have finally passed the ordiance granting to John H. Nicoll a street railway franchise.

1†RIVERSIDE, CAL.—Wiring has been begun on the electric railway to Crestmore, and it is thought that the road will be in operation by April 1. This road is about 6 miles long and will be operated by the Riverside & Arlington Railway Company, which is owned by H. E. Huntington.

2†SAN FRANCISCO, CAL.—In addition to considerable new steam equipment the Northwestern Pacific Railroad Company has recently received 13 passenger coaches for use on its electric third-rail system from Sausalito to San Rafael.

1-2†SAN FRANCISCO, CAL.—The San Francisco, Oakland & San José Railway Company is making plans for the extension from Oakland to San José of the Key Route lines, and it is stated by an official of the company that the actual work of grading the road and laying the rails will begin in the near future, probably within two or three months. In preparation for the operation of this branch of the system and for use on the Claremont Avenue line, ten new suburban cars, such as are now used on the Key Route, are being built at the car shops of the system on Fortieth Street. Five of these cars are rapidly nearing completion and will be ready for use by April 15, and all of them will be completed by May 1.

2†NEW HAVEN, CONN.—The Connecticut Company has just received a shipment of 16 new double-truck open cars.

oAMERICUS, GA.—It is reported that the Americus Railway & Light Company will soon place contracts for rails necessary for the construction of four miles of its line. J. H. Hagerty is the general manager of the company.

3†ATHENS, GA.—C. D. Flanigen, manager of the Athens Electric Railway Company, writes that the following equipment was recently contracted for: a 1000 kw Allis-Chalmers turbine, 290 hp in boilers, Blake condensers and a 15-ton crane.

oATLANTA, GA.—Arrangements for beginning work on the Atlanta-Carolina Electric Railway are being rapidly perfected, and it is expected that work in Atlanta will begin about May 1. Work at this end will commence with the city system contemplated by the new company, and this will be finished before the work of connecting the suburban end is undertaken. The Atlanta terminal will be at Broad and Alabama Streets, and the road will run to Madison Avenue and then to the various points in the city from Garnett Street. The materials for the road in Atlanta have been ordered and they are expected in Atlanta in time for operations, to be commenced on May 1. M. T. Edgerton is secretary of the company.

oBOISE, IDAHO.—The Gooding-Milner Electric Railway Company has awarded the contract for the building of its line from Gooding to Milner to the firm of Grant & Son, of Faribault, Minn.

*ALTON, ILL.—C. F. Stelzel, of Granite City, is authority for the statement that Alton is to have another electric street railway through a portion of the city. The line is to run from First and Ridge Streets, up Ridge to Fifth and thence north to the north side. The new line will take in a section not in touch with any car line. The necessary franchises have not been secured.

1-4†CHICAGO, ILL.—We are officially informed that the Chicago City Railway Company expects to build 60 miles of new track in the coming year. It is also planned to erect a car house. All the arrangements for material in connection with the above improvements have practically been closed.

oCHICAGO, ILL.—The operation of the Chicago, Lake Shore & South Bend Railroad between South Bend and Chicago is promised by July 4. Eleven miles of construction work, including the building of a bridge and the ballasting of the road, are all that remains to be completed. The tracks have been completed in the western part of South Bend. The company will enter over a route granted in a franchise from the City Council. The line will follow Colfax Avenue and traverse a private right of way to Laparte Avenue and thence over Lasalle Avenue to Main Street. The local system will be ready for service about April 15. The Nichol Building has been leased and will be converted into a modern terminal station. Here the general offices of the company will be located. The interurban cars for the new road are wider than those used on the Chicago, South Bend & Northern Indiana Railway Company's line from Warsaw to South Bend. They have baggage, smoking and general passenger compartments. In addition to the passenger equipment there are 30 ballast cars of the latest and most approved type and five locomotives. The company has a long-time contract with the Illinois Central Railroad to carry its cars over its line from Hammond to Randolph Street in Chicago, landing passengers within a short distance of the Auditorium Annex. The road runs direct from South Bend to Michigan City, a distance of 33 miles. From Hudson Lake to Michigan City it opens up a new field for South Bend merchants. The road actually owned by the company will extend from South Bend to Hammond, a distance of 70 miles, passing through Lydick, Terre Coupee, New Carlisle, Hudson Lake, Michigan City, Dune Park, Millers Aetna, Gary, Indiana Harbor, East Chicago and Hammond.

*SPRINGFIELD, ILL.—The Secretary of State has issued a license to incorporate the Interlake Railroad Company. The principal office is Chicago, and the capital stock is nominally $5,000. It is proposed to construct an electric railway from Lake Michigan to Fox Lake, in Lake County. The incorporators and first board of directors are Otto Hopper, S. N. Conway, Martin D. Smith, A. F. Struckman and S. S. Welcher.

oEVANSVILLE, IND.—The Evansville Terminal Railway Company, which was incorporated recently, has applied to the town board of Newberg for a franchise to enter that town with a new line. Among the incorporators of this company are: M. S. Sonntag and J. V. Rush.

oINDIANAPOLIS, IND.—Agents are at work securing the right of way for the proposed electric railway to be built by the Indianapolis & South Bend Traction Company between South Bend, Plymouth, Rochester, Logansport, Burlington and Indianapolis. Over 50 miles of the right of way have already been secured, and it is intended to begin constructing the road by June 1. It is estimated that the total length of the road will be 71 miles. The capital stock of the company is $10,000,000. E. M. Bowman is president; O. H. Mann, secretary, and J. H. Keller, treasurer. The main office is at the State Life Building, Indianapolis.

oDAVENPORT, IA.—A meeting of the directors of the Davenport & Manchester Railway Company was held in Davenport last week and was attended also by representatives from Manchester, Monticello, Davenport and other cities and towns along the proposed route. The completed surveys with maps, profiles and estimates, together with the report of W. H. Kimball, who made the surveys, were received and gone over, and the proposed line, which is 93 miles in length, was reported to be, with a few exceptions, an easy one to construct. Those interested in promoting the road hope shortly to complete arrangements for financing the project.