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## Independent Motor Cars

Mr. Dawson's admirable discussion of this topic, which we publish elsewhere in this issue, is most timely. There is and has been for a considerable time, a keen interest in the feasibility of such practice, more especially abroad, and there is no doubt that for certain cases, an independent motor car is most convenient. As a factor in ordinary tramway work it can hardly be considered important, since when traffic reaches the density which justifies a tramway, the ordinary trolley equipment is preferable. But there certainly are many branch railway lines, and other lines where traffic is small, on which the ordinary locomotive is burdensome in expense unless the idea of fairly frequent service is abandoned. Such lines demand an equipment of low cost and low upkeep, but generally need motors of only moderate power and speed. Heretofore the main reliance has been that nondescript thing, the "steam dummy," which has been tried in various forms for years with rather indifferent success. It was generally a sort of cross between a switching engine and a caboose, with the vices of both. When a branch or cross-country line is not too long and a source of power is available, the trolley system is probably more useful than any other, but the cost of equipment and operation is burdensome unless conditions are favorable. The development of the automobile has given a new impulse to the construction of independent motor cars, which we think will be productive of important results. Gibe at the "devil wagon" as one may, the world owes it a debt of gratitude for the impulse it has given to the improvement of small prime movers of every sort, and the result of this impulse will extend to machines of larger importance.

Mr. Dawson describes at some length the various motor cars which have come into use, and comes to the conclusion, which we are disposed to indorse, that the car driven by a simple petrol or gasoline motor is on the whole the best solution of the problem yet presented. The steam motors are highly ingenious and efficient, but rather complicated, and open to the objection of giving a rather heavy car with very limited capacity for its weight. The petrol cars, on the other hand, are light, simple to operate and cheap to run. As grade climbers they are hardly equal to the steam cars, but on the other hand, the lines on which they are used generally do not require sharp grades. The other two possibilities which Mr. Dawson considers, are the accumulator cars and the petrol cars with electric transmission gear—that is, with the engine working a dynamo from which the driving motors are fed. The plain accumulator car is, according to ordinary experience, condemned by its weight and the upkeeps of the batteries. The petrol-electric car, an interesting type of which we described last week as applied to highway service, is open to the same objection as regards weight, and is of high first cost. In road work where the way must be shared with other vehicles, the delicate speed control of this type of car is unquestionably very valuable, albeit the price paid for it is relatively high, but on a track in the class of work we are discussing, it is a question whether the game is worth the candle. To be sure, one serious item of expense, the tires, is avoided in case of a railway, but for the cases in which an independent car is desirable, it is doubtful whether the improvement in control justifies the addition of the electrical outfit. Certainly the plain petrol car is amply capable of meeting the requirements in most instances.

The lightness and simplicity of the petrol car is greatly in its favor, and the first cost is moderate. It strikes us that in the ordinary road with very light service, these qualities are of prime importance. The pity is that such cars have not been developed with engines using petroleum oils other than the very light ones now employed. We do not agree with Mr. Dawson that the supply of these special products will remain ample enough to keep down the cost if the demand increases as it has of late. Gasoline is a meager by-product of the main oil industry, and while light oils are now cheap, it will take no great extra demand to make them dear, particularly as the oil business of the world is in the power of a very few huge concerns. Even the small shortage in the anthracite supply two years ago sent the price of fuel oil skyward. But it is fairly certain that explosion engines for the heavier oils are feasible, e. g., the Diesel machine, and they will probably be soon put into practical shape for the purpose before us, if the demand continues. A first-class petrol car equipment for railway use would be especially valuable in the case of light cross-country lines, on account of the moderate cost of equipment and the light weight, which permits the laying of moderately light track. At present, nearly all such lines are built with rather heavy rails to permit operating locomotives, or if designed for electric traction, are still heavily built in accordance with the practice standardized on lines for large traffic. The cases for which independent motor cars are especially fitted are those in which the traffic is, and is likely to remain, too small to justify a regular trolley outfit. Such cases are rather numerous among feeders to railroads and on rural lines, particularly those largely dependent on summer business. It is hard to forecast the future in any particular situation, but it is broadly true that there are many places in which the growth of business is likely to be small, although transportation facilities are really needed. For such lines the independent motor cars have much to recommend them. Their development will be measured by that of the automobile, for they are automobiles operated on exceptionally smooth roads without the need of rubber tires at a week's receipts per set. Aside from work which may be permanently light, they are capable of doing well on lines in a growing country where the traffic will eventually justify a regular electric line. Such temporary use would often save the day financially.

## A New Form of Extortion

One of the reasons why the transportation business never grows dull and tame to those engaged in its executive duties lies in the ever-persistent ingenuity with which a certain portion of the general public stays awake nights to devise new methods of mulcting the operating companies. This time some of the citizens of Marlboro, Mass., are attempting to acquire fame by a new form of extortion in connection with the Boston & Worcester Street Railway Company's sub-station that is now being built on Maple Street.

It seems that the company has petitioned the Board of Aldermen for the right to build a three-phase line carrying current at 13,000 volts from the Framingham power station to the new sub-station, and the possibility of such a current's entering the precincts of Marlboro has aroused the avarice of various irresponsible citizens to the extent of a demand that the current shall not be brought into the town without the payment by the company of a sum of money adequate to salve the consciences of those who would otherwise consider the plan a dangerous one. It is earnestly to be hoped that this ridiculous proposition will receive the death blow it deserves, from the Board of Aldermen. One would naturally suppose that after permission had been given the company to build its sub-station in the town, no further opposition would arise as far as its logical completion was concerned. As for the voltage under consideration, there is no great difficulty in insulating a line for 15,000 volts, or even 20,000 volts, in a thoroughly satisfactory manner, and the little town of Southboro, which adjoins Marlboro, has readily granted the company permission to run its lines through the community. Scores of cities and towns are to-day carrying arc circuits at voltages closely approximating 8000, and although there is no doubt that underground lines represent the most advanced practice in densely populated communities, there would seem to be little need of them in a small city like Marlboro. The weakness of the opposing citizens' stand is best evidenced by their willingness to gloss over the supposed danger for the consideration of a few greenbacked sugar plums. Certainly, with proper construction and inspection, there is no reason why a 13,000-volt line should not be maintained in as safe condition as lower potential arc and alternating circuits, either of which are amply capable of killing people through carelessness in handling or poor construction. We trust that the Marlboro Aldermen will dispose of this new species of attempted graft in short order.

## A Weak Spot in Steam Railway Operation

Accidents occurring on steam and electric railways may be divided into two general classes: preventable and unavoidable casualties. Although it is difficult to draw a hard and fast line between the two groups, it is certain that the occurrence of calamities which "might have been avoided" brings its own peculiar sorrows and losses—oftentimes all the more bitter and lasting because of the lack of human foresight implied.

Of the latter character would seem to be the recent fatality on the Grand Trunk Railway in the St. Clair tunnel, where six employees were suffocated by coal gas as a result of the breaking in two of a train which was passing through the tunnel. According to press despatches, three of the crew were asphyxiated while part of the train lay stalled in the tunnel; the engineer lost his life when returning in the attempt to push the stalled cars back to a place of safety, and two other rescuers were killed by the gas in trying to save their comrades.

We cannot but believe that if electric instead of steam locomotives had been in use in the tunnel, the accident would not have occurred to cost these men their lives. Perhaps there is no place so well fitted for the operation of electrically propelled trains as a dark, smoky tunnel. The collision in the Park Avenue tunnel of the New York Central lines last year demonstrated this beyond the shadow of a doubt, and the work of electrifying the suburban lines of that system, which is now under way, marks a great forward step in the interests of safety, quite apart from its other advantages. The experience of the Baltimore & Ohio road in the famous Belt Line tunnel at Baltimore, is unquestionably on the side of the electric locomotive against its sulphurous and uncleanly cousin.

It is in no spirit of carping criticism that we would bring these facts to the attention of all those who are striving to perfect the safety of operation upon both steam and electric railway systems. Destructive criticism defeats its own ends unless something better than the existing régime can be suggested. The object of these comments is to point out a remedy for the present conditions in tunnels traversed by air-befouling steam locomotives, in the hope of inducing a change in operating methods which will insure that death by asphyxiation shall be made practically impossible hereafter. One does not like to think of what would have happened, perhaps, if a heavy train load of passengers had been subjected to the fumes which proved to be the deadly enemies of the employees concerned in the Grand Trunk accident. Certainly the day is coming sooner or later when the steam locomotive will be banished, not only from the congested districts of our great cities, but from tunnels under rivers and mountains from the Berkshires to the Cascades. There are no insurmountable technical difficulties in the way of thus making this weak spot in steam railway operation strong. Accidents are pretty sure to happen under modern conditions of railroading, no matter what precautions are taken, for human knowledge and foresight are subject to human limitations; but this fact in no way excuses those in charge of the movement of traffic upon our transportation systems from employing every means known to the business in the attempt to prevent those casualties which have of late grown so alarmingly frequent.

### Misuse of Electric Heaters

We think it only fair to the electric heater to call attention to a very common fault on the part of companies purchasing electric car heating equipments, which fault usually results in the end in a condemnation of electric heaters. This fault lies in trying to get along with a few heaters worked at a high temperature rather than a large number working at a lower temperature. The reason why many companies attempt to do this is, of course, to reduce the first cost of heater equipment. If a car is to be heated as comfortably by electric heaters as by hot water, the nearer we can come to distributing the heat evenly throughout the length of the car and avoiding excessively hot points, the better will be the results. It is coming to be more and more established that heating of any kind can be done more efficiently by a large radiating surface worked at low temperature than by a small radiating surface worked at high temperature. Furthermore, working electric heaters at low temperature is conducive to a long life, while working them at high temperature is not.

It is not our purpose to enter here into an academic discussion as to why a car can be heated with less energy by using a large radiating surface in the heaters than by using a small radiating surface, but it seems to be well established by a number of experiments that have been carried on in the past few years. The first electric car heaters were worked at much higher temperature than is considered good practice to-day, and their efficiency was poor as compared with the electric heaters of to-day. The improvement is largely due to the increased radiating surface which is common at present. It is therefore in order when getting electric heaters to get plenty of them.

### Turn-outs and Accidents

The location of turn-outs is always an important question in the construction of a single-track electric road. In many cases the possible solution of the problem is at best approximate, because of the conflict between the theoretical location determined by the schedule and the location as fixed by public safety and the cost of construction. The highway may be too narrow for cars to pass one another with safety to teams, or it may be that physical obstacles are present which would cost too much money for removal. From first to last, however, safety to both the company and the public is the vital point in laying out this kind of track work.

A recent accident is suggested in this respect. At the bottom of a long hill the company built a turn-out with a turn to the right at the foot of the grade, the main line of track being continuous for cars ascending the incline. While a car was standing upon this main line at the bottom of the hill, a motorman lost control of his own car while descending the grade, and the speed acquired at the bottom was so high that the runaway car did not take the turn-out, but collided with the stationary car, with a resulting loss of life.

In the particular location where the accident happened, the changing of the turn-out to the other side of the track would doubtless cause a certain inconvenience to vehicles traveling upon the road, but it would enable the outward-bound car to take the siding by a turn to the right, leaving the main line free for the car coming down the grade. There would consequently be slight chance of a collision in case of a runaway down the hill, as far as the operation of the turn-out is concerned. Such a change in the turn-out would certainly be preferable to giving the outward-bound car instructions to take the switch by a turn to the left. Special movements are always to be avoided in railway operation when the work of transportation can be carried on by regular movements. The slight inconvenience to passers-by on the road caused by an occasional team's having to wait for the cars at the turn-out would seem to be a small matter in comparison with the added safety secured to a far greater number of passengers traveling by the electric road. Points of this kind are well worth considering, in cases like the above.

### Centralizing Repairs

One of the papers and discussions at the recent American Railway Mechanical and Electrical Association convention was on "The Ideal Shop." If present plans are carried out for standing committees, this subject will occupy the attention of conventions for several years to come, and it is well that it should, because there are always a number of companies considering the erection of new shops. One phase of the question to which we have referred editorially during the past year, which was not taken up at the last convention, but which must certainly enter into the question of the ideal shop as one of the most important factors, is that of how far the centralizing of repairs is to be carried out. Are the main shops to do only the more important repairs or are all cars requiring anything but the slightest repairs to be run to the central shops? The answers to these questions will determine much in the design and size of the main shops. There is certainly a tendency in designing new shops to work toward the idea of centralizing as much of the repair work as possible. This is in accordance with the general policy of consolidation and centralization which has been going on in all large organizations, but every little while we see a reaction from this; or, if not a positive reaction, a tendency to modify original plans for centralizing repairs. This is a complex question, as there are so many things to be considered on both sides. Against centralized repairs we have the cost of the dead mileage of cars in getting them to and from the repair shop and the loss of time incident thereto. Against the plan of doing all repair work possible in the car houses of each division is the fact that the work does not come as directly under the supervision of the master mechanic as at one main shop. The facilities for repairs in car houses are not usually as good as in central shops, and there must be maintained at each car house a store of repair parts and supplies if repair work is not to be unduly delayed. On a large system the dead mileage necessary to reach a main repair shop which serves the whole system is a considerable item of expense. How much of an item it is likely to be must be calculated for each specific case. The result of an investigation of this point may sometimes be an improvement of the facilities for repairs at various car houses. As a rule, car house repair facilities are much inferior, even as regards minor repairs, to facilities at main shops, but if these minor repairs are to be carried on at division car houses, it is not economy to have anything but the best facilities for handling them.

## THE USE OF INDEPENDENT MOTOR CARS ON RAILWAYS

BY PHILIP DAWSON

A great deal has recently been heard in Great Britain, on the Continent and in the United States about the great advantages to be gained by the electrification of main line railways, particularly in connection with the rapid handling of crowds in and around large cities. Electrification of railways, as far as long-distance traffic is concerned, has been discussed from time to time, but as steam traction for long distance and goods traffic has proved economical, there is little chance in the near future of electric traction generally replacing steam for this work.

There is another function which main line railways have to accomplish and of which less has been heard—the serving of the various small towns on their systems. Some of them are located on main lines and others on small branch lines, the districts being sparsely populated and generally rural. In the case where small towns are situated on main lines, express trains do not usually serve them, and a number of local trains are run daily, connecting the stations with the big cities. Branch lines are usually worked the same way, a single train being sufficient to run the whole service. In order to operate economically under such circumstances, it is necessary to reduce the number of trains as much as possible, and the time between trains is therefore very great, and the inhabitants, instead of availing themselves of the trains, to keep their appointments in the neighboring districts, either drive, ride or walk. The consequence of this is two-fold, the railway loses traffic which it might secure and the intercommunication between the various small towns is limited, as people only travel from absolute necessity. In most of such cases the construction of electric tramways and light railways operating electrically would not pay, and for this reason, in many rural districts of the United Kingdom, small companies are being formed to operate motor cars, which compete with the railways. Unfortunately, the working costs of such cars are heavy. The railway companies are at last beginning to realize that great increase of traffic may be obtained by running single carriages carrying their own motive power instead of steam locomotives hauling long trains, which, in most cases, are but partly filled with passengers.

American companies, such as the Westinghouse and the General Electric Company, are already placing on the market petrol electric cars which are specially intended to deal with this particular kind of traffic.

The railway companies of Great Britain, in consequence of the constant increase in working expenses and decrease of the receipts available for dividends of capital expenditure, are looking out for means by which the dividends may be increased. They are considering electrification where traffic is so intense and the service so frequent that this method is justifiable, and are turning to motor cars to increase traffic on their branch lines. Several English companies are installing services of road motor cars, connecting stations with villages and small towns which are not already served by railway or tramway. In this connection the Great Western Railway has already done a large amount of pioneer work and has obtained most satisfactory results. The intentions of this company appear to be to develop traffic by means of 'bus services, which will eventually justify it in building electric tramways, or short branch lines to deal with the demand for traveling facilities created by the motor 'bus service.

The great advantage of motor cars operating on railways is that by this method all tire troubles are at once eliminated and the general cost of operation reduced, the complications of construction are decreased by elimination and the differential gear.

The types of automobiles which have so far been tried on railways may be divided into three classes, viz., electric cars, steam cars and petrol cars.

### ELECTRIC AUTO CARS

Where no continuous conductors are carried along the line from which current can be collected, accumulators have to be employed, and this is the only type which can be claimed to be an electric auto car. Although experiments were carried on several years ago by Mr. Heilmann with a form of combined steam and electric locomotive, with the object of obviating the necessity for accumulators, the results obtained were so far from encouraging that this system need not be taken into consideration in the present article. A modification of this system, wherein a petrol engine is substituted for the steam engine, is being tried by the North-Eastern Railway Company in England, and is also being advocated in America by the General Electric Company.

Accumulator cars have so far proved failures financially, owing to the very heavy cost of maintenance, repairs and renewals of the batteries and their low efficiency.

The Adriatic Railway Company, of Italy, has operated accumulator cars on the Bologna-Modena line since December, 1900, and on the Bologna-St. Felice-Poggio line since May, 1901, but this service has now been abandoned.

The following are the special features which are claimed for the installation:

1. The special car devoted to the construction and installation of the cases which contain the batteries.

2. The facility with which the cases could be put in and removed several times a day, to examine the elements and change the batteries.

3. The adoption of a switchboard for coupling the batteries in series, and for the eventual cutting out of any one of them without stopping the train.

The electrical equipment consisted of a battery of 288 cells, divided into three groups of batteries, and also the two motors, in series or in parallel, besides being capable of reversing the motion or cutting out the motors. A separate battery consisting of twenty cells was provided for lighting the car.

The batteries were charged at Bologna and Poggio-Rusco; with one charge the cars ran 74 km (46 miles) on the Bologna-Modena branch at a maximum speed of 60 km (37.3 miles) per hour; 84 km (52.2 miles) on the Bologna-St. Felice branch at a maximum speed of 40 km (24.8 miles) per hour; 60 km (37.3 miles) on the Bologna-St. Felice-Poggio-Rusco branch at a maximum speed of 40 km (24.8 miles) per hour.

During experimental runs these motor cars have traveled at a speed of 60 km (37.3 miles) per hour for distances of 90 km (55.9 miles), Parma-Bologna, and 94 km (58.4 miles), Bologna-Ferrara. The energy consumed by the motors, taken on a two years' average, was 23 watt-hours per ton kilometer, or nearly 37 watt-hours per ton mile. The batteries were supplied fixed and maintained by the Societa Italiana di Elettricità gia. Cruto.

The following figures give some details of weights, etc., of accumulator cars:

TRACTION BATTERY

| | Kgs. | lbs. |
|---|---|---|
| Weight of cell casings | 2,110 | 4,652 |
| Weight of lead plates | 5,776 | 12,69'1 |
| Weight of ebonite | 650 | 1,433 |
| Weight of glass | 16 | 35 |
| Weight of connections | 123 | 271 |
| Weight of acid | 1,967 | 4,336 |
| Total weight of traction battery | 10,622 | 23,417 |
| Total weight of lighting battery | 377 | 831 |
| Total weight of car excluding the batteries | 33,240 | 73,281 |
| Total weight of car complete | 44,239 | 97,529 |

Passenger capacity of motor cars:

| | Seated | Standing |
|---|---|---|
| Second class | 20 | 8 |
| Third class | 32 | 8 |
| Total | 52 | 16 |

The distance between the chief points on the route are as follows:

| | km. | miles |
|---|---|---|
| Bologna to San Felice | 42.48 | 26.40 |
| Bologna to Poggio-Rusco | 59.42 | 36.92 |
| Bologna to Modena | 36.93 | 10.52 |
| San-Felice to Poggio-Rusco | 16.94 | 10.52 |

These cars were operated under a guarantee of the company who supplied the plant, and who operated it for a period extending over two years. The results obtained during this time have decided the railway company to discontinue the use of accumulator cars. The experiment has not proved satisfactory, and the cars have been taken off the line and returned to the contractors.

The company has now reverted to running ordinary steam trains, and has not yet adopted any other type of motor car, either steam or petrol, nor, as far as can be ascertained, is any such action contemplated at present. The concessions under which the railways are worked will shortly expire, and after it has been decided whether the Government will operate the lines itself or grant fresh concessions to operating companies, a large number of Italian lines will undoubtedly be electrified, and among others, the Poggio-St. Felice line.

The experience of the Würtemberg State Railways, with accumulator carriages, has also been unsatisfactory, and merely confirms the results obtained in Italy. In the beginning of August, 1897, the company put into service an ordinary third-class passenger carriage mounted on two bogies, each fitted with one 30-hp motor. The accumulators were fitted in a special tray hung from the longitudinal beams supporting the car body. The prescribed speed was 25 km to 30 km (15.5 miles to 18.6 miles) per hour on a gradient of 1 in 100. It was found impossible to haul a trail car, as there was not room under the car body to install a battery of sufficient capacity. A series of experiments with this car were made in 1897. The battery was found to be too small, and a new and larger one was put in and fixed under the seats of the car. In 1900 the car was put into regular service and ran until 1901 on the line between Friedrichshafen and Ravensberg. The line has few curves, the difference between levels of termini is 32 m (105 ft.) and the maximum gradient is 1 in 45, and extends for 161 m (176 yards); the only other gradient of importance has a slope of 1 in 200, and is 2.8 km (1.74 miles) in length. The car has seating room for fifty-six passengers and standing room on the back platform for eight passengers.

The storage battery used during the period of regular running consisted of 188 cells and weighed 8.65 tons. The battery had a capacity of approximately 200 amp-hours, and supplied current at from 335 volts to 380 volts; it had to be recharged each round trip of 40 km (24.85 miles). With this battery it was found possible for a motor car to haul one trail car weighing 11.3 tons, making the total weight of the train operated 39.6 tons. The rapid deterioration of the battery is shown by the fact that while, when new, the amount of energy consumed measured at the charging station was 25 watt-hours per ton kilometer (40.25 watt-hours per ton mile), the average for the fifteen months during which the car was running was 38 watt-hours (61.25 watt-hours per ton mile), or more than 52 per cent greater. The high cost of maintenance, combined with the rapid decrease of the efficiency of the battery, made it necessary to take the car out of service. The losses in the storage battery were very considerable. During the above-mentioned period of running it was found that nearly 54.5 per cent of the electrical energy put into the accumulator at the charging station was put into the cells. There is nothing surprising in these figures, which might have been foreseen, and which only confirm the experience gained in tramway work.

Both the Northern Railway of France and the Paris-Lyons-Mediterranean have experimented with accumulator cars, but in no case have the experiments proved satisfactory financially. For some time the Paris-Lyons-Mediterranean ran an accumulator car between Paris and Mellun; this car weighed 40 tons and could run 120 km (74.56 miles) on one charge. The results obtained were not satisfactory and the car is no longer in service.

The Italian Mediterranean Company ran an accumulator car between Milan and Monza, but the results were not encouraging, and there seems little doubt that the car will very shortly be taken off the line.

### STEAM CARS

Steam cars may be divided into two types, the first are built on ordinary locomotive lines; the boilers are usually of the locomotive type, and the engines of the ordinary slide valve pattern, similar to those employed for locomotive work. Such carriages have been used for a long time past on the Belgium State Railways, on what are called the "Trains Tramway." The London, Brighton & South Coast Railway Company has been experimenting with a car of a similar design between Fratton and Southsea. The Great Western Railway Company is also experimenting with similar cars built at its locomotive works, and apparently with very good results.

The Taff Vale Railway Company has built a steam car which carries twelve first-class and forty second-class passengers, and there is also a luggage compartment. The first-class compartment has longitudinal seats; the second-class seats are arranged transversely in pairs, divided by a central gangway. Heating is done by steam from the engine on the D. G. Peters system. Two gangways give entrance to the car, one at the guard's end leading into the first-class, and one between first and second-class leading into both. The gangways are fitted with collapsible gates and steps, giving access to the road level. The steps can be swung back to the width of the ordinary footboard when not in use.

The underframe of the car is constructed of steel, and is carried at one end on an ordinary carriage bogie, and at other by the engine. The chief dimensions are given below:

| | Feet | Inches |
|---|---|---|
| Length of carriage body | 45 | 0 |
| Width of carriage body (outside) | 8 | 6 |
| Length of second-class compartment (inside) | 26 | 1½ |
| Length of first-class compartment (inside) | 8 | 11 |
| Width of gangways | 2 | 8 |
| Height from floor to roof | 7 | 2½ |
| Wheel base of carriage bogie | 8 | 0 |
| Wheel base of engine | 8 | 6 |
| Diameter of wheels | 2 | 10 |
| Total length of car over buffers | 58 | 9 |
| Distance between centers of bogies | 48 | 9½ |
| Longitudinal distance between inside pairs of wheels | 32 | 9½ |
| Total wheel base | 49 | 3½ |
| | Tons | Cwt. |
| Total weight | 32 | 2 |

The boiler is of the multitubular type, constructed of steel plates with a copper fire box; there are 312 tubes 1¼ ins diameter. The working pressure is 160 lbs. per square inch The cylinders are situated between the wheels and outside frame, the connecting rod being coupled to the end pair of wheels. The valve gear is worked by ordinary eccentrics on the driving axle, and the valves are on top of the cylinders. The Stevenson link motion is used, and the engine is reversed by screw reversing gear. Both steam and hand brakes are provided.

The fire grate area of the boilers is 8 sq. ft., and the total heating surface is 338.5 sq. ft., which is made up of 39 sq. ft. for the fire box and 299.5 sq. ft. for the tubes.

The engine cylinders measure 9 ins. in diameter x 14-in. stroke. The wheel base of the engine is 8 ft. 6 ins., the wheel being of the same size as those of the bogie, viz., 2 ft. 10 ins.

The water tank holds 530 gallons, and the coal bunker 10 cwt. of fuel.

When running with the engine at the rear, the guard can communicate with the driver by means of an electric bell; he can also shut off steam, sound the whistle and apply a hand brake on the carriage bogie.

Where special types of boilers and engines are used these take up less space than is required by the ordinary type, and weights are considerably reduced. A type of machine specially constructed to fill the requirements of railways has been designed and constructed by M. Serpolett, of Paris. This type has been found to give results when applied to propelling automobiles on ordinary roads. There is another type manufactured in France which has been experimented with on the Paris-Mediterranean Railway and by the Paris-Orleans Company. It has been designed and constructed by M. V. Purrey, of Bordeaux, who has for many years been constructing a special type of boiler and engine used on several of the Paris tramway lines. The Paris-Lyons-Mediterranean ordered two of these carriages from the inventor in 1901, the conditions laid down being as follows:

The carriage to contain thirty to thirty-five seats for the passengers, eight to ten second-class, and the rest third-class and standing room for ten on one platform.

The carriage to go up a gradient of 1 in 50 with its full complement of passengers at a speed of 20 km per hour (12.4 miles per hour).

The car on down gradients or on a level to be able to run up to 60 km (37.3 miles) an hour without undue vibration. The car to run 60 km (37.3 miles) without taking in fuel, and 30 km (18.6 miles) without taking in water.

These cars have now been running for about eighteen months and, generally speaking, their operation appears to have been fairly satisfactory. At the same time several repairs appear to have been necessary. The crank shafts proved too weak and had to be replaced by some of stronger design.

The two Purrey cars are operating on a branch line of the Paris-Lyons-Mediterranean in the south of France, between Alais and Ardoise. This line is 60 km long (37.3 miles), and each of the two motor cars does the distance twice, that is to say, runs 120 km (76.56 miles) per day.

A plan and section of the car is shown in Fig. 1, from which it will be seen that there is a platform on the front on which the driver and the boiler are accommodated. In accordance with standard Paris-Lyons-Mediterranean practice, the carriage is mounted on a four-wheel truck. The motor is fixed in an inclined position above the front axle and drives a countershaft connected by pitch chains to the driving axle. This system of driving has been adopted in order to reduce the size of the steam engine, and is a very usual method employed with motor car work on ordinary roads. Some manufacturers prefer to use a live axle and dispense with chains, but this plan has the disadvantage of requiring flexible joints to compensate for the movement of the springs to which the motors are fixed.

The following are the principal dimensions of the boilers used:

Capacity, 262 liters (57.7 gals.).
Pressure, 20 kg per sq. cm (approximately 284 lbs. per sq. in.).
Heating surface, 26 sq. m (280 sq. ft.).
Grate area, 0.84 sq. m (9.04 sq. ft.).
Diameter of steam drum, 0.4 m (1 ft. 4 ins.).
Thickness of boiler plated composing steam drum 20 mm (0.79 ns.).
Length of drum, 1.25 m (4 ft. 1 in.).
Thickness of vertical portion of mud drum 25 mm (0.98 ins.).
Thickness of horizontal portion of mud drum, 25 mm (0.59 ins.).
Number of lower tubes, 24; the tubes are 1.6 m long (5.25 ft.), 17 mm (0.67 ins.) internal diameter, and 4 mm (0.16 ins. thick).
The number of upper tubes is 49; they are 6.7 m (22 ft.) long, 17 mm (0.67 ins.) internal diameter; 2.5 mm (0.16 ins.) thick.
The boiler is fitted with two safety valves, the diameter of the steam escape of which is 24 mm (0.94 ins.).

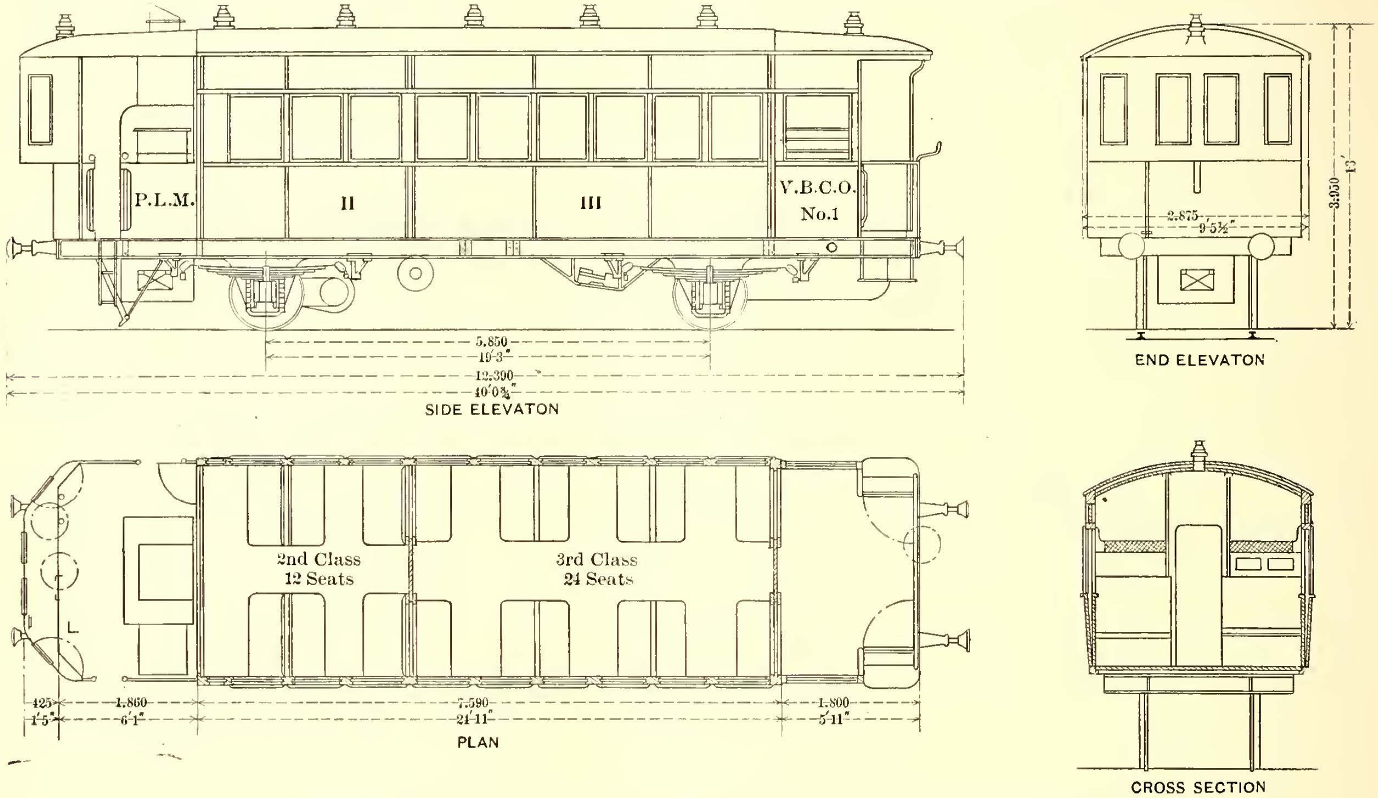


FIG. 1.—CONSTRUCTION DETAILS OF STEAM MOTOR CAR. PURREY SYSTEM

Owing to the high pressure at which the boiler is worked and the very variable level of the water, no water gage is fitted, and there are no blow-off cocks to show the height of water in boiler. The fuel used under the boiler is coke. The bunker, which contains 280 kg (617.3 lbs.), is placed on the left hand side of the boiler; the bottom of this is inclined at an angle of 30 degs., and is connected to the grate in such a way that the vibration of the car is sufficient to cause the coke to feed on the grate automatically. The fire only requires attention when the car stops; the driver then looks at the fire and takes away clinkers that may have formed. The fire box is fitted with two dampers, by which the driver can regulate the draft and the intensity of the fire. A water tank having a capacity of 1280 liters (282.2 gallons) is fitted at the back of the car in such a way that its weight equalizes the pressure of the two axles.

The steam engine is of the four-cylinder double-tandem-compound type, as shown in the illustration accompanying this article. The diameter of the high-pressure cylinders is 140 mm (5.5 ins.), and of the low-pressure cylinders 200 mm (7.87 ins.), and the stroke is 200 mm (7.87 ins.). The connecting rod is 600 mm (23.6 ins.) long. The steam distribution is on the slide valve principle, one eccentric being provided for each pair of cylinders. Reversing is done by changing the angle of the eccentrics.

With this arrangement it is not practicable to change the point of cut-off as is done in the case of ordinary locomotives, as it would involve too much complication. There are only two levers, one going forward and the other for reversing. The transmission is by means of a chain of special design, which is 190 mm (7.47 ins.) wide, 3.3 m (1.8 ft.) in length, and weighs 120 kg (264.5 lbs.).

The seating capacity of the coach is thirty-six—twelve second-class passengers and twenty-four third-class passengers. There is also standing room on the back platform for twelve passengers. The carriage is lighted by seven oil lamps, and Westinghouse brakes are fitted. Below are given the results of two series of tests which were carried out when the cars were new.

In the first series the cars were run at a low average speed (a) by themselves, (b) with one trailer attached, (c) with two trailers attached. The route in each case was between Alais and Ardoise, a distance of 58 km (36 miles).

The motor car weighed 23.8 tons, and the trailers 14 tons each.

The following results were obtained:

First series.—Low average speed tests:

(a) Motor car by itself. Total weight, 23.8 tons.

Boiler pressure throughout trip, 8 to 10 kgs. per sq. cm (114 to 142 lbs. per sq. in.).

Average coke consumption on round trip, 2.7 kg per car km (9.58 lbs. per car mile).

Average water evaporated, 4.5 liters per kg of coke (4.5 lbs. per lb. of coke).

(b) Motor with one trailer attached. Total weight 23.8+14 tons=37.8 tons.

Boiler pressure 14 kg. per sq. cm (199 lbs. per sq. in.).

Average coke consumption, 2.9 kg. per train km (10.3 lbs. per train mile).

Average water evaporated, 4.9 liter per kg. of coke (4.9 lbs. per lb. of coke).

(c) Motor car with two trailers attached. Total weight, 23.8 + 14+14 tons=51.8 tons.

Boiler pressure, 20 kg. per sq. cm (284 lbs. per sq. in.).

Average coke consumption, 3.9 kg. per train km. (13.85 lbs. per train mile).

Average water evaporated 4.5 liters per kg. of coke (4.5 lbs. per lb. of coke).

In each of the above tests the schedule speed was easily maintained with the boiler pressure as stated. In running from Ardoise to Alais, the maximum speed attained was 55 km per hour (34.2 miles per hour), and the minimum speed was 20 km per hour (12.4 miles per hour). On the return journey from Alais to Ardoise, the maximum speed was 45 km per hour (28.0 miles per hour) and the minimum as before. The average speed, including stops, for the whole run from Ardoise to Alais was 29 km per hour (18.0 miles per hour); the average for the reverse was 24.8 km per hour (15.4 miles per hour), the time taken for the run being two hours and four minutes one way and two hours and twenty-four minutes the other.

During the third test, with two trailers, the train negotiated a gradient of 1 in 50, at a speed of 20 km per hour (12.4 miles per hour).

Second series minimum speed tests.

(a) Motor car run by itself. Total weight, 23.8 tons.

Boiler pressure varied between 8 kg and 20 kg per sq. cm (114 lbs. and 284 lbs. per sq. in.).

Average consumption of coke, 3 kg. per car km. (10.65 lbs. per car mile). Average water evaporated, 4.5 liters per kg of coke (4.5 lbs. per lb. of coke).

(b) Motor car with one trailer attached. Total weight, 23.8 tons+14 tons=37.8 tons.

Boiler pressure varied between 8 kg and 20 kg per sq cm (114 lbs. and 284 lbs. per sq. in.).

Average consumption of coke, 4.3 kg car train km (15.3 lbs. per train mile).

Average water evaporated, 4.5 liters per kg of coke (4.5 lbs. per lb. of coke).

In both of the above tests it was found impossible to keep the boiler pressure at all constant.

The maximum speed on a down grade was 60 km (37.3 miles) an hour. An average speed of 36.5 km (22.7 miles) an hour was maintained both on the outward and on the return journey,

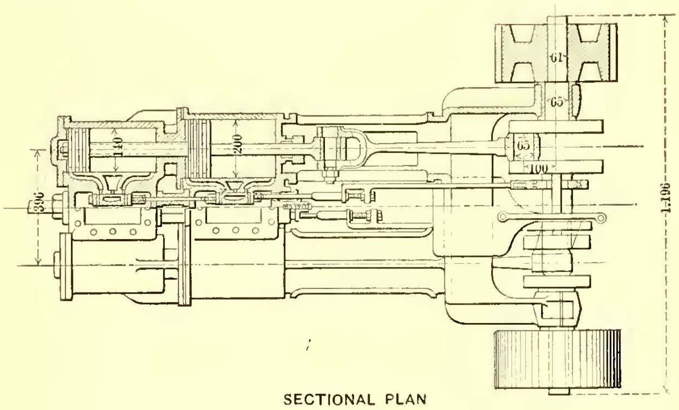


FIG. 2.—SECTION OF PURREY ENGINE

this completing the distance in one hour and thirty-eight minutes.

The consumption of water and coke in the above tests is given per train-kilometer. Reducing these figures to per ton mile we find that the consumption of load water for the low-average speed tests varied between the following limits:

| | |
|---|---|
| Coke .............................. | .267 lb. to .4025 lb. per ton mile |
| Water ............................ | 1.2 lbs. to 1.81 lbs per ton mile |

The Würtemberg State Railways has for some years been experimenting with Serpollet cars.

The experiments with their first Serpollet car were commenced in February, 1897; the whole apparatus, as far as engines and boiler were concerned, was supplied by the inventor, Monsieur Serpollet, of Paris. The car was a four-wheel one, with one driving axle; the wheel bases of two of the cars tested were 4 m (13 ft. 1½ ins.) and 4.6 m (15 ft. 1 in.), respectively, and contained thirty-three and forty seats, with standing room for eight passengers on the back platform. The steam engine was connected direct to the driving axle, and not by chains, as in the case of the Purrey cars already mentioned. The diameter of the cylinders was 300 mm (11.8 ins.). The diameter of the carriage wheel was 1000 mm (39.4 ins.); the heating surface of the boiler was 11.1 sq. m (119.5 sq. ft.), and the steam pressure was 18 kg per square centimeter (256 lbs.) per square inch, and the temperature of the steam never exceeded 450 degs. C., which corresponds to a superheat of 435 degs. F. A water tank was fitted to the car with a capacity of 820 liters (181 gallons); the boiler was fired with briquettes. The conditions imposed on the makers were as follows:

The carriage must carry forty-eight passengers, the weight of the car, including passengers, to be 21.2 tons; it was to attain on a level a speed of 40 km (24.8 miles) per hour. During actual running on gradients of 1 in 100, the car attained a speed of 40 km (24.8 miles) an hour, and when hauling a trailer weighing 13 tons on the same gradient, the speed realized was 27.5 km (17.1 miles) per hour.

In the usual tests the motor cars are either run independently or with one trailer car.

It has been found very difficult with this type of car to regulate the speed, as it was not found practicable to vary the amount of steam generated in accordance with the requirements; during stops, steam always blew off and tubes were very liable to burn out. The driving of these cars appears to require highly skilled labor. The amount of steam reserve in these boilers is so very small that in bad weather, or with an abnormally heavy load, the steam may give out altogether. Generally speaking, the results obtained appear to leave much to be desired. The cost of repairs and renewals are high, and for a considerable portion of each year the cars have to be laid by for cleaning and repairing purposes.

### PETROL CARS

The petrol cars may be divided into two classes. In the first a combination of petrol and electricity is used, the petrol engine driving an electric generator which, sometimes in connection with a battery and sometimes without, supplies current to electric motors; in other words, the transmission between the petrol engine and the axle is done electrically instead of mechanically. The reason for experiments being carried out with this system is that petrol engines are not self-starting, and that it is not practicable to reverse them or to vary their speeds except within comparatively narrow limits. For this reason both reversing and changing speeds have to be obtained by means of some kind of gearing, which, in the case of the road motor cars, no matter how well it may be designed, will absorb 40 per cent to 50 per cent of the power actually developed by the engine. In the case of a car running on rails, greater efficiency could be obtained, as there would be no need for a differential gear, and also because the gearing could be made heavier and therefore more efficient since a slight increase in weight would not matter. Under these circumstances the efficiency obtainable between the engine and the wheels of the car should not be much under 80 per cent.

Although the use of electrical transmission greatly facilitates starting and reversing and speed variation, it adds considerably to the first cost as well as to the weight of the motor car, and takes up valuable space which otherwise might be utilized for passenger accommodation, and at the same time only increases the efficiency very slightly.

Experiments with combined sets are being made by the North-Eastern Railway Company, but no figures are as yet available.

This car was made by the Wolsey Tool & Motor Company, of Birmingham. The engine has four horizontal cylinders 8½ ins. diameter and 10-in. stroke. When tested it developed 92 bhp at 400 r. p. m., and over 100 bhp at 480 r. p. m., the consumption at the latter output being .78 pints per horse-power. This works out at a mean effective pressure of 80.3 lbs. per square inch, not including that expended in overcoming friction. The engine has a fly-wheel 3 ft. in diameter, through which it is coupled direct to a 60-kw Westinghouse electric generator; the small exciter is driven by a belt. The current from the dynamos drives electric motors geared to the car axles. All inlet and exhaust valves of the engine are mechanically operated by cams on two cam shafts, one each side of the engine.

The weight of the electrical portion of this car is as follows:

| | Lbs. |
|---|---|
| Generator, bed-plate, exciter, rheostat and switch panel.... | 7,700 |
| Two motors, controller, diverter, circuit breaker, wiring and cables | 6,400 |
| Storage battery for lighting | 900 |
| Magnetic brake | 500 |
| | 15,500 |

Hence, total weight of electrical equipment is just under 8 tons.

The engine is governed on the throttle, and by means of auxiliary gear the driver can hand-throttle the engine from either end of the coach. Ignition is obtained by means of ordinary accumulators. Forced lubrication is employed for all main bearings.

Experiments have been and are being made with this system for road motor cars, but up to date have not been satisfactory.

Messrs. Turgan Foy et Cie have recently built a paraffin tram car for the Chemins de Fer de la Drome. The Turgan car is supplied with a four-cylinder vertical engine, which can use either petrol or paraffin. The cylinders are 100 mm (3.94 ins.) in diameter and 110-mm (4.32-in.) stroke, and the engine develops 16 hp when running at a speed of from 800 r. p. m. to 1000 r. p. m. An ordinary leather-faced clutch and propeller transmission gear driving on to the axle is used. The two axles are, however, connected by outside connecting rods. Both the engine and the variable-speed gear box are carried upon a secondary frame slightly below the ordinary frame work of the truck at the fore end of the car. A universal joint is introduced between the variable-speed gear and the differential gear on the rear axle. The car is well provided with appliances, these being both hand and foot operated. The former applies hand brakes equally on the rear wheels, while the latter not only brings into play two other hand brakes, but also applies shoe brakes simultaneously and equally upon all four wheels.

The car is 4.53 m (14 ft. 10 ins.) long, 1.7 m (5 ft. 7 ins.) wide, and 2.78 m (9 ft. 1.45 ins.) high.

The total weight of the car is 3870 kg (8532 lbs.), which is made up as follows:

| | Kg. | Lbs. |
|---|---|---|
| Chassis engine and fuel | 2,400 | 5,291 |
| Body engine and fuel | 700 | 1,543 |
| Ten passengers and conductor | 700 | 1,698 |
| | 3,870 | 8,532 |

There are two tanks containing, respectively, 60 liters (13.23 gallons) of liquid fuel and 100 liters (22.05 gallons) of cooling water.

### DESCRIPTION OF BRITISH DAIMLER CAR. (DICK, KERR & CO.)

Both the Great Northern Railway and the London, Brighton & South Coast Railway Company, after most careful investigation, are realizing the necessity of improved means of communication on their branch lines. Mr. Bury, the locomotive superintendent of the Great Northern Railway, after a careful study, has decided to experiment with a petrol car, and with this end in view has entrusted Dick, Kerr & Company with the order for an experimental car, which is now completed, and which will run on one of the branch lines of the Great Northern Railway Company. The motor equipment of this car has been constructed by the Daimler Company, of Coventry. As soon as its operation proves satisfactory it is probable that a large order for similar cars will at once be placed by the Great Northern Railway Company.

The writer, as consulting engineer of the London, Brighton & South Coast Railway Company, has most carefully considered the best method of dealing with the traffic on their branch lines, and after having personally investigated what has so far been done on the Continent and in England, has come to the conclusion that the petrol car, pure and simple, appears to have the greatest promise, and it is expected that the London, Brighton & South Coast Railway Company will shortly inaugurate a service of petrol cars on their branch lines. With this end in view, designs have been got out for such a car.

In applying internal combustion engines to vehicles for roads or railways, especially where great tractive efforts are necessary, it is essential that means be provided to allow of the attainment of large starting efforts, a variable tractive effort, and speed and reversal of motion.

The arrangement of the motors as carried out for Dick, Kerr & Company by the Daimler Company, of Coventry, is novel, and appears to have features which should render it very successful. A general plan of the arrangement and side elevation are shown in Fig. 3, and details of gear and clutches are shown in Fig. 4. From these it will be seen that the coach in question tershafts geared to them are mounted bevel wheels, meshing with others at the ends of the longitudinal shafts. The reversing is effected by mounting two bevels loosely on each axle or countershaft gearing on opposite sides of the bevel on the longitudinal shaft. The clutches are mounted on two axles or

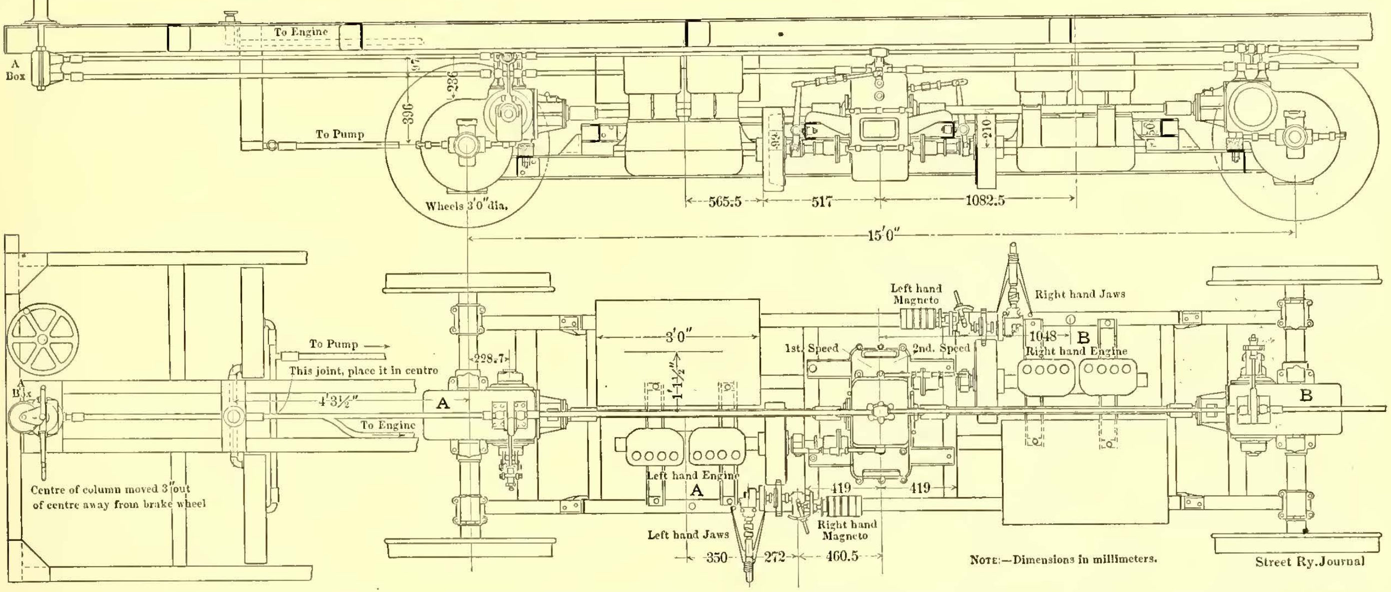


FIG. 3.—BRITISH DAIMLER MOTOR CAR AS PROPOSED FOR GREAT NORTHERN AND LONDON, BRIGHTON & SOUTH COAST RAILWAY

is a four-wheel one, and that two motors are used, each having four cylinders. One motor is located at each end of the car and at opposite sides, and the motors drive by means of a clutch countershafts, and so arranged as to be capable of being operated simultaneously. These cause the forward or backward movement of the vehicle by clutching the one or the other of the

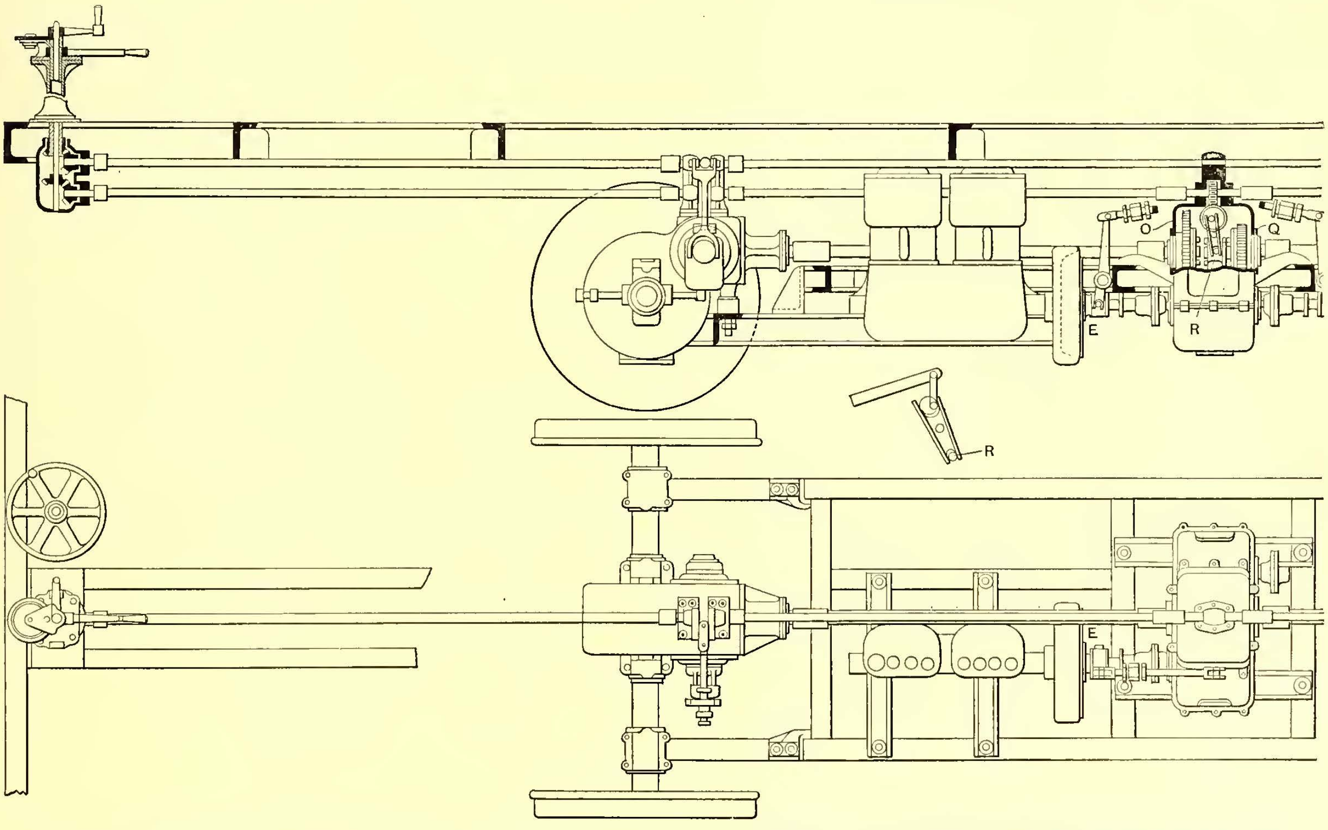


FIG. 4.—BRITISH DAIMLER MOTOR CAR, METHOD OF CONTROL, SHOWING TWO-SPEED AND REVERSE LEVER AND CONNECTION BETWEEN THE TWO

on the two shafts working on the common gear case. There are two forward speeds and one reverse. The common gear box is connected by means of one shaft to the two axles, which are driven simultaneously from it.

In order to obtain maximum traction both axles are driven from one center longitudinal shaft. On the axles or the countershafts geared to them two bevel wheels fast to the axle or countershaft, the remaining wheel of each pair running idle and all wheels being permanently in mesh.

The two internal combustion engines are placed one on each side of and with their crank shafts parallel to the longitudinal center shaft already referred to.

On the crank shaft are mounted clutches of such nature that when simultaneously operated by the driver the engines may be put into or withdrawn from engagement with the transmission gear gradually and without shock.

The two engines drive through clutches, the shafts connecting into the common gear box.

On each of the engine shafts are mounted two pinions. These pinions are permanently in gear, with the wheel mounted loosely about the longitudinal center shaft. One pinion of each engine is permanently in gear, with a wheel also mounted loosely about the center, and the other wheel of each engine is geared to a second loose wheel on the same center shaft.

By means of a two-way positive clutch, either of the wheels may be locked to the shaft, causing it to rotate to a speed depending upon the ratio of the gearing. The clutch is actuated from the driver's platform.

CONTROLLING MECHANISM

In working this motor it is essential that means be provided for:

1. Applying or withdrawing the motor-driving power from the axles gradually and smoothly, the motors running continuously in one direction.

2. For changing the ratio of speeds and torques between motor shafts and axles.

3. For reversing the direction of motion of the vehicle.

These ends are attained as follows:

At both ends of the vehicle are mounted a controlling pillar provided with two levers, as shown in Fig. 4. One lever is fast upon the vertical shaft and the other lever is fast upon a tube surrounding the shaft.

At the bottom of the pillar are two pairs of bevel wheels, one set being fast on shaft and tubes, respectively. The other two wheels are fast upon two short shafts, respectively, coupled by suitable universal joints to two longitudinal shafts.

With suitable joints where necessary, the two longitudinal shafts extend the whole length of the vehicle, and are coupled up to a duplicate controller at the opposite end of the vehicle.

By this arrangement when the car has started the gear has to be put in, when the gear is put in the clutch is put in and slowly thrust in in such a way that when it first begins to revolve a certain amount of slipping motion takes place, which is sufficient to get the car started on its movement, and the clutch is thus slowly pressed home until the pressure is sufficient to prevent any slipping. Before the car can be reversed the main operating lever must be brought to the off position, that is to say, the engines must be out of gear and the clutches must be out; when this is done the reverse must be put in and the car can run backwards.

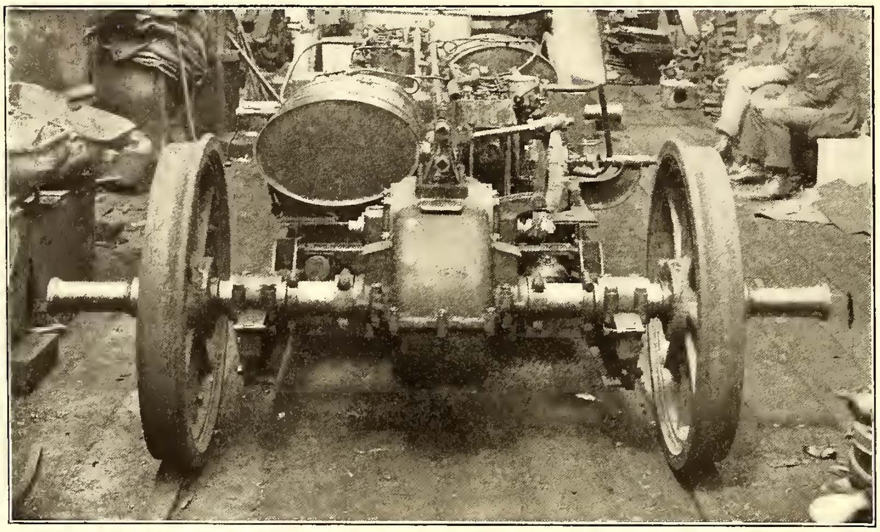

FIG. 5.—BACK VIEW OF TRUCK OF BRITISH DAIMLER CAR, SHOWING THE CAR BOX ON AXLE AND THE PETROL TANKS

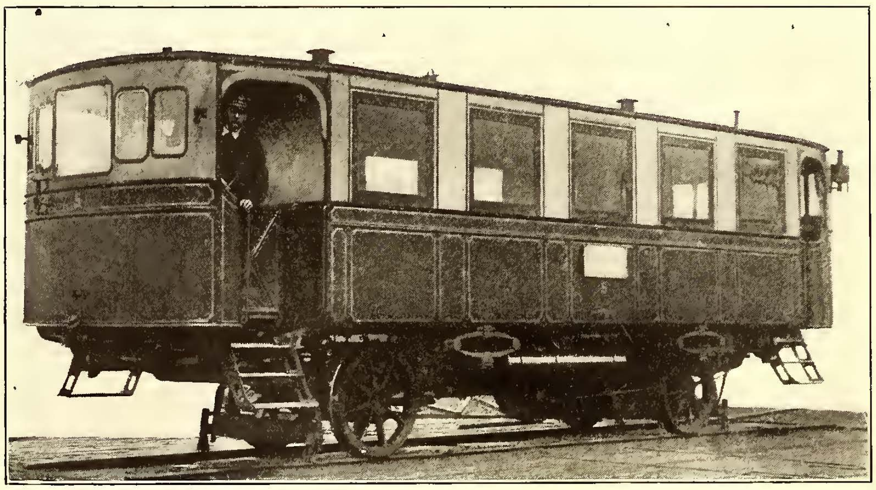

FIG. 9.—SIDE VIEW OF WURTEMBERG PETROL CAR

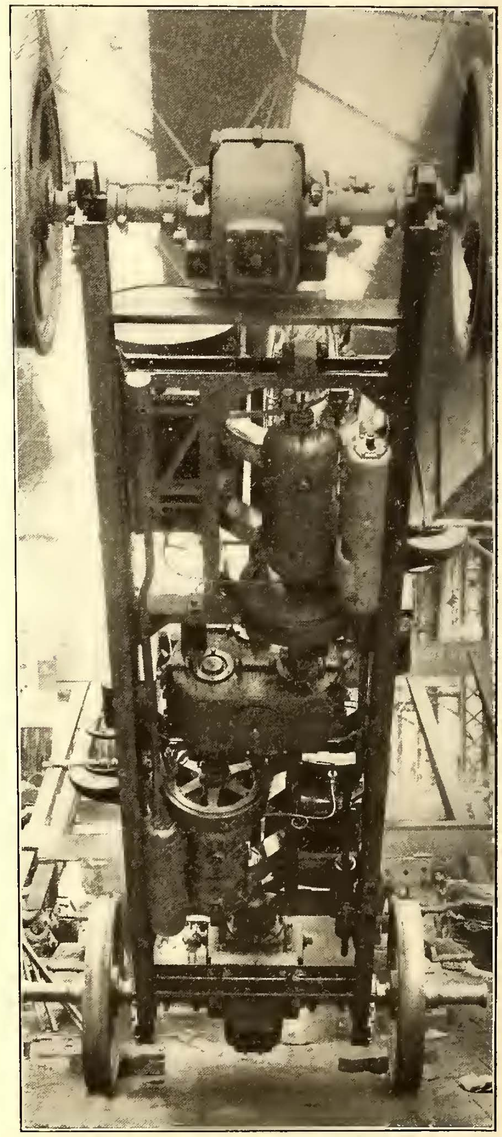

FIG. 7.—VIEW OF THE LOWER PORTION OF TRUCK OF BRITISH DAIMLER CAR

The Engine—The bore of the cylinders is 110 mm, the stroke of the pistons is 150 mm, at a speed of 750 r. p. m., 28-brake-hp is developed. The cylinders are cast in pairs with water jackets.

The pistons are fitted with four rings, two rings being placed in each of the two grooves. The connecting rods are of stamped steel, the bearings being of phosphor bronze lined with plastic white metal. The crank shaft is a solid forging. The cranks are set to fire 1, 2, 4, 3, counting the cylinder nearest to the radiator one.

The inlet and exhaust valves are on the left hand side of the engine, and are mechanically operated by an unenclosed cam shaft. The cam shaft is operated from a steel pinion placed at the rear end of the crank shaft, gearing into a fibre toothed ring mounted on a light malleable iron wheel. On the opposite or forward end of the cam shaft is fitted a bevel pinion, enclosed in a light brass case; this pinion operates the vertical shaft of the commutator and high-tension distributer.

The illustrations, Figs. 5, 6 and 7, which are from photographs specially taken for this article, show the back view of the truck, showing the gear box on the axle and the petrol tanks; the side view from which the starting handle is shown, as well as the box containing the battery and magneto, the high-tension distributer and carburetter; and a very interesting view showing the lower part of the truck. From this last view the arrangement of the fly-wheel of the common gear box, into which the two engine shafts operate, and the through shaft connecting the two axles, is clearly seen. The small cylinders at either end nearest the side frame are silencers into which the engines exhaust.

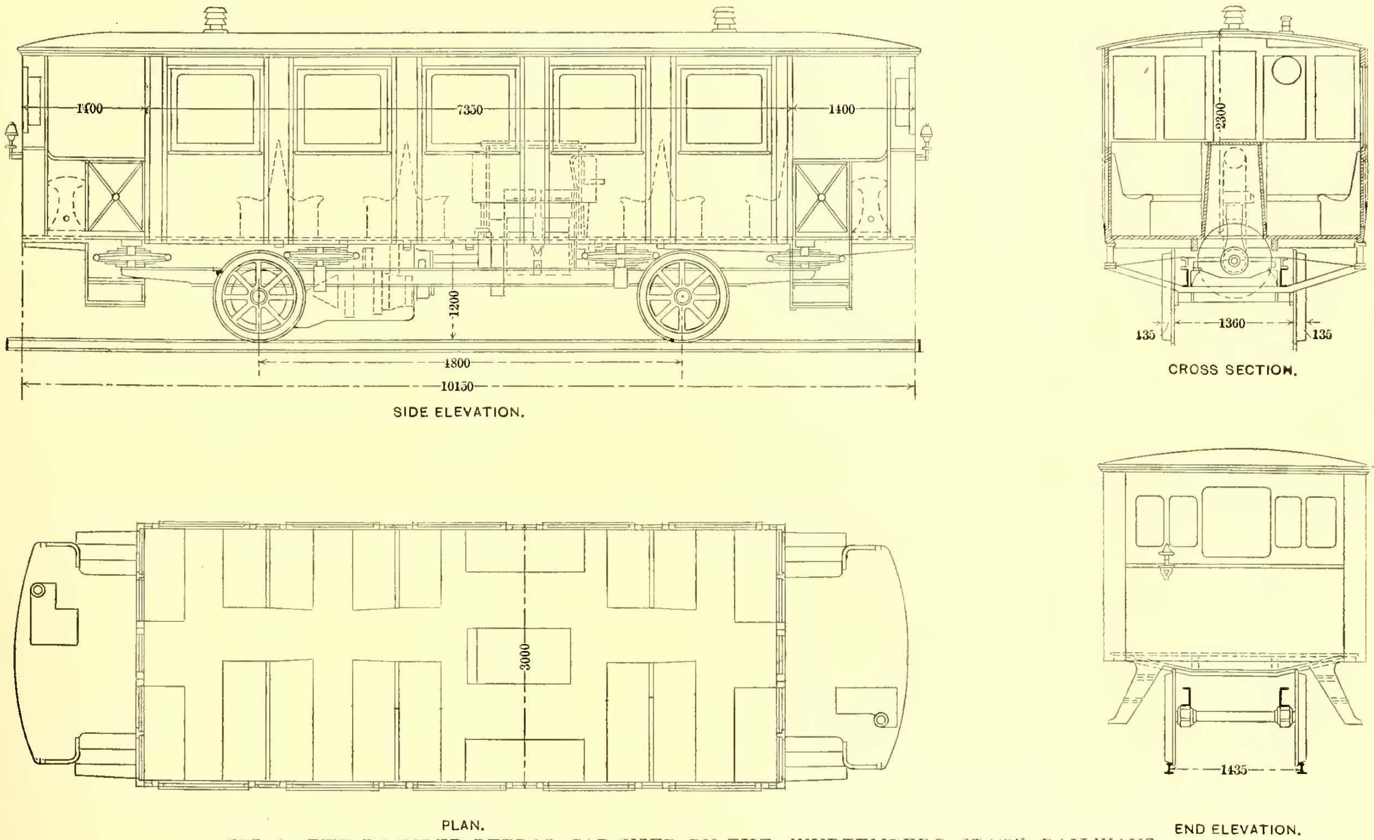


FIG. 8.—THE DAIMLER PETROL CAR USED BY THE WURTEMBERG STATE RAILWAYS

In order to obtain maximum traction both axles are driven from one central longitudinal shaft. On the axles or on countershafts geared to them are mounted bevel wheels, meshing with others at the ends of the longitudinal shaft. The reversing is effected by mounting two bevels loosely on each axle or countershaft gearing on opposite sides of the bevel on the longitudinal shaft. Clutches are mounted on two axles or countershafts, and so arranged as to be capable of being operated simultaneously. These cause the forward or backward movement of the vehicles by clutching the one or the other of the two

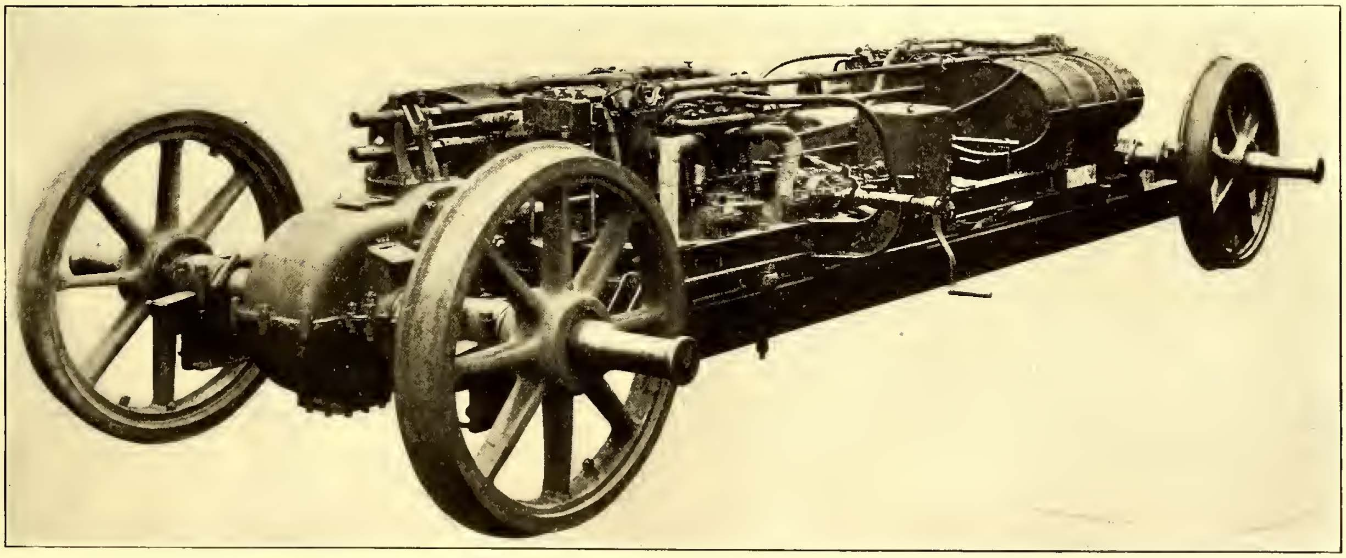

FIG. 6.—SIDE VIEW OF TRUCK OF BRITISH DAIMLER CAR, SHOWING STARTING HANDLE

bevel wheels fast to the axle or countershaft, the remaining wheel of each pair running idle and all wheels being permanently in mesh.

Mercedes Cars—Up to the present the people who have the most extensive practical experience of the petrol type of motor car as applied to railway work are the Daimler Motoreen Ges-

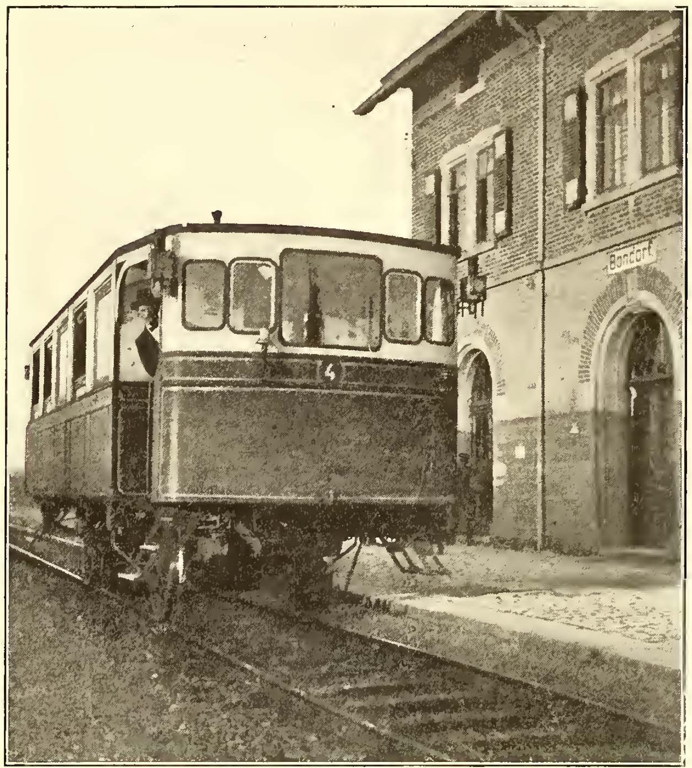

FIG. 10.—END VIEW OF PETROL MOTOR CAR USED BY THE WURTEMBERG STATE RAILWAYS

selschaft, of Cannstadt; these people have manufactured and delivered five cars for the Würtemberg State Railways, one for the Swiss State Railways, and one for the Hungarian State Railways, and they are at the present time supplying two new cars for the Würtemberg State Railways.

The Würtemberg State Railways has five petrol motor cars

FIG. 12.—MOTOR CAR OF GREAT NORTHERN RAILWAY IN STATION AT GRANTHAM

in regular service, the first of which was put into service in December, 1893, over ten years ago. They make use of three sizes. The first car delivered in 1893 had a wheel base of 2.4 m (7.88 ft.), and seated twenty-four passengers, with room for eight more on the rear platform. The brake-horse-power of the four-cylinder Daimler motor was 14 hp; these cars proved too slow. The next car put into service had a wheel base of 4 m (13 ft. 1½ ins.), and a seating capacity of thirty passengers, besides having standing room for eight more on the back platform. It was fitted with a 20-brake-hp engine. The most recent cars delivered have a wheel base of 4.8 m (15.7 ft.). They seat forty-four passengers, besides having standing room for eight, and are fitted with a 30-brake-hp motor. In all three cases the diameter of the driving wheels is 1000 mm (39.4 ins.), and the over-all width of the car 3 m (9 ft. 10 ins.), and the maximum height of the car 4 m (13 ft. 1½ ins.). The complete weight of the 20-hp motor car, including equipment, is 12 tons, and of the 30-hp, 13 tons.

The cars which are now going to be ordered by the Würtemberg State Railways will each be fitted with one four-cylinder 70-hp engine. The new car will seat fifty-two, and there will be room for eight to stand on the back platform; it will be capable of hauling one trailer at a speed of 25 miles to 35 miles an hour. The writer spent nearly a whole day riding on a similar car which is in regular service near Stuttgart on a single-track line between Lenskirch and Saulejau, and the running was very smooth and pleasant. A drawing of the car as well as photographs of it are reproduced in Figs. 8, 9 and 10.

A peculiar and objectionable feature of the cars so far delivered is that there is no spring between the motors and axles, but only a spring suspension of the car body. The motors themselves are mounted at about the center of the car, as shown by the diagram, and are enclosed in wooden cases, which are easily removed to give access to the motors. The carriages are double-ended, with a platform at either end, each fitted with brake levers, speed-reversing levers and clutch, so that the motor can be operated from either end of the car. There is only one driving axle. A petrol tank under the car carries sufficient fuel under the car to run continuously for ten hours. The type of clutch used on all these cars is that manufactured by the Coil Clutch Company, of Bristol, England, and has proved quite satisfactory. The present cars have four speed and one reverse speed, but practice has shown that these four speeds are not necessary, and the new cars will only be fitted for two speeds. The present cars drive by means of bevel gearing and have one live axle, but it is proposed to drive the new cars by means of chains, and the motor will be spring borne.

The three types mentioned are not powerful enough to haul trail cars on the hilly lines over which they operate, but when

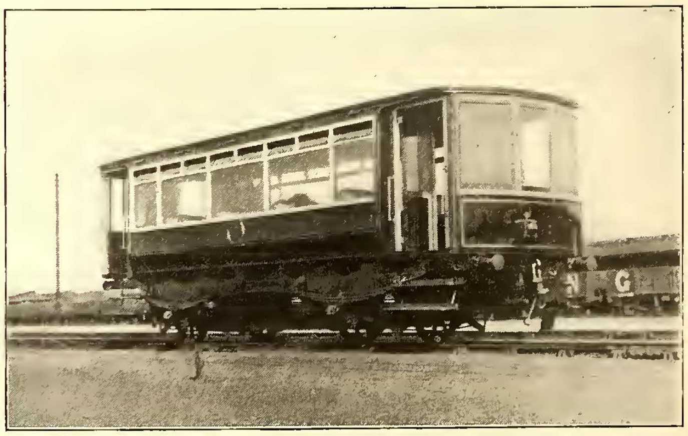

FIG. 11.—MOTOR CAR OF GREAT NORTHERN RAILWAY IN YARDS AT DONCASTER

more powerful engines are used they will be able to haul one 14-ton trailer. The 30-hp car when loaded with passengers weighs about 17 tons, and tests have shown that in dry weather and under favorable conditions this car can keep up a speed of 40 km (24.8 miles) an hour on the level; on long gradients of 1 in 100, 26 km (16.1 miles) an hour. When using petrol of specific gravity of .680 to .700, the 20-hp cars are guaranteed not to consume more than .425 kg (.134 gallons to .138 gallons) per British horse-power-hour. In regular service it has been found that with an average speed of 28 km (17.4 miles) an hour, .019 kg of petrol was used per ton-kilometer (.00975 gallons per ton-mile).

The petrol cars have each done in regular service 60,000 km (37,283 miles) per year; the average daily work of the car when in service is 182 km (113.1 miles), and one-seventh of this total distance is on a gradient of 1 in 22. The average traveling speed of the 30-hp car is 25 km (15.5 miles), and the average consumption of petrol .26 kg per car-kilometer (.132 gallons to .136 gallons per car-mile).

COMPARISON OF PETROL AND PETRO-ELECTRIC CARS

The comparison of the relative advantages of electric transmission from a petrol motor to the driving wheels of the car and direct mechanical transmission from the same motor to the car wheels, show on almost every point great advantages in favor of mechanical transmission.

Weight—The relative weights are enormously in favor of the mechanical transmission, for, while the gear boxes and the transmission shafts from two petrol motors of from 30 bhp to 50 bhp each would weigh about 20 cwt., the equivalent electric generator and two electric motors and switch gear weigh nearly 7 tons. Therefore, with electric transmission the power to propel the car must be increased owing to the added useless weight, which amounts to half the total weight of a 70-hp petrol carriage.

Capital Cost—This again is enormously in favor of the mechanical system.

Operation and Maintenance—This again is in favor of the mechanical system, for the amount of fuel which will be used for the propulsion of the car, with the greatly increased weight involved in the application of the electrical method, must be proportionally more than with the lighter weight of the mechanical transmission. Further, there will be the added cost of maintenance and depreciation of the electric generator, while in regard to the maintenance of gearing, that will be much the same in both the electrical and mechanical methods, as both petrol and electric motors drive the axles by means of gearing.

Experience extending over ten years has shown that the petrol cars require comparatively little maintenance and are reliable as long as they are looked after. The annual number of miles run, that is to say, the service which has been got out of the cars, is nearly double that given by electric steam cars.

Passenger Accommodation—This point again is largely in favor of mechanical transmission, for in that case the entire engine and gearing goes beneath the car floor, leaving the whole of the interior of the car from end to end available for the service of passengers; while in the electrical method quite a large portion of the car has to be devoted to the space required for the engine and generator.

Flexibility—In this point, no doubt, the electrical transmission has advantages over the mechanical, as, undoubtedly, greater flexibility as to speeds can be obtained with the electrical method. But while such flexibility as this would be useful for road cars which have to slow up when meeting other traffic, and are continually stopping and starting, it is not necessary with cars running in a railway, where they generally have unchecked runs from stopping place to stopping place, and under such conditions the mechanical system has quite sufficient flexibility to meet all possible requirements, for, while the engine has not the same range of control of speed as a steam engine, it can be quite sufficiently controlled on the throttle to produce those variations in speed which are necessitated by railway running.

There seems little reason to doubt that the petrol engine, pure and simple, with ordinary gearing both for reversing and changing speeds, is the most practical method at present in existence.

CONCLUSIONS

Accumulator Cars—Accumulator cars have been experimented with for many years, and have been discarded owing to the heavy cost of maintenance and their limited running powers, as well as their heavy capital cost. There remain, therefore, only two types of cars to be seriously considered, viz., steam cars and petrol cars.

Steam Cars—These cars are divided into two types, the ordinary light locomotive type, such as has been generally introduced in recent years in England, and special types, such as the Serpollet. As regards first cost, there is little to choose between the two, but the latter type is more delicate, and although the cost of repairs may not necessarily be heavier than in the case of the other, yet a very considerable amount of time is required to effect these repairs. Also, since the cars can only be used for a limited period, a larger number of them is required to operate a given service than would otherwise be necessary. As regards cost of repairs, it must also be borne in mind that the ordinary type of steam motor car as employed in England has only been in service for a short time; notwithstanding this fact the cost of maintenance per car-mile, per ton-mile and per seat-mile is considerably higher than the cost of maintenance of the Serpollet cars, and it is quite possible that this cost in the case of the light locomotive type may become even greater than at present, after the cars have been running for a longer period of time. This is not the case with the Serpollet cars. The cost of fuel and of maintenance is lower in the Serpollet car than in the ordinary steam car, but the former requires more care in driving, and it is very difficult to regulate the amount of steam generated; the train is either blowing off steam at stations or steam may give out entirely just when it is most wanted, on gradients, in greasy weather, or if the load happens to be exceptionally heavy.

Petrol Cars—These drawbacks do not apply to petrol cars. No skilled labor is required to drive them; and whereas a petrol car can be started in two or three minutes, it takes from twenty to thirty minutes to start a Serpollet car, and considerably more time to get up steam in a motor car of the ordinary English type.

There is a further advantage with petrol cars, in the fact that when starting in the morning, while it takes from fifteen to thirty minutes to start a Serpollet car, a petrol car can be started in from one to two minutes, and when once in regular running it can practically start itself. It would, of course, be possible to start the engine by compressed air, but this would only add to the expense and complication, and starting is so easy that such an arrangement is, I think, undesirable. This is shown by the fact that whenever a stop at stations exceeds three minutes the driver stops his motor and economizes the fuel. This is impossible with a steam car, the motor of which wastes fuel when standing still.

It has been urged against petrol cars that they are not constructed of sufficient power, and that, therefore, steam cars are preferable. This is a mistaken idea, as it is perfectly possible, if necessary, to equip a petrol car with two 100-hp motors instead of with two 35-hp or one 70-hp motor, as is being done at present. Petrol motors are regularly constructed up to 100 hp and more, and there is no reason why two motors of that power should not be used if found advisable.

The chief reasons which have caused steam cars to be built of greater power than petrol cars are that it would be much more difficult and not much less costly to build a steam car with a 70-hp engine and boiler than with a 200-hp one, and that the ordinary type of steam equipments are so heavy, and the weight of fuel and water which has to be carried is so great, that it runs up the total weight of the car, and thus requires a larger amount of power than is the case with a petrol car. This is clearly shown in Tables I. and IV., where it will be seen that the steam cars used on the Taff Vale Railway and the Great Western Railway weigh between 32 tons and 35 tons each, while the petrol cars only weigh from 13 tons to 15 tons, or less than half. Petrol cars constructed with a 70-hp engine could easily haul a trailer if required, and goods carriages could always be attached provided the train could be run at a lower speed, and the ordinary petrol cars operating passenger traffic in the day time could be used as locomotives to haul goods trains at night.

The petrol car has the advantage over the ordinary type of steam cars that it can be worked from either end, and so does not require turntables; furthermore, it has the advantage that all the machinery can be located under the body of the car, thus leaving the whole floor space available for passengers or luggage. An additional advantage is that the engine can be shut down whenever the time of stopping exceeds two or three minutes, thus economizing fuel and lubricating oil. With a petrol car it will be possible to arrange it in such a way that one man will be sufficient to drive the car, in exactly the same way as tram cars are operated in our streets. In considering the cost of operating and the results obtained, it should be remembered that the fact of a motor car giving better results than the steam trams it has displaced on lines of light traffic is not proof that the particular type of steam car adopted is most suitable for the work. It merely shows that there is a field for motor cars in this branch of traffic, and the improved results are largely owing to the traffic which this particular mode of transit has developed. In the case of the Great Western line between Chelmford and Stonehouse, the number of passengers carried has been increased eight-fold by the introduction of a motor car service.

There are three bases upon which results can be compared, viz.: cost per car-mile, cost per ton-mile and cost per seat-mile. Where locomotives are used to haul several carriages, the total weight does not effect the cost of haulage to any very great extent, and hence it has been usual to figure out the cost per train-mile. When steam motor cars are used the cost per train-mile becomes cost per car-mile, and in that case it is probably more advantageous to work out the cost per seat-mile, as it is the number of passengers which can be carried for a given cost which is the best index as to which system is most advantageous.

It should be borne in mind that it is practically certain that at no very distant date it will be possible to use ordinary paraffin oil, such as is burnt in lamps, or even of a cruder and therefore cheaper grade, in place of petrol. To a limited extent, it is possible to do this already, although a certain amount of difficulty is entailed owing to the engine having to be started up on petrol and the supply of petrol then cut off and paraffin substituted, which involves complications. At the present moment special carburetters are being experimented with, and there is little doubt that in a very short time one will be designed which will permit the use of paraffin oil alone. As this would not necessitate any other change in the engines, the moment this difficulty is overcome the cost of fuel would be considerably reduced, as ordinary lamp oil could be obtained far more cheaply than petrol.

There is, moreover, little fear of a "corner" in petrol being formed, since many new sources for its supply are constantly

TABLE I.—CHIEF DETAILS OF STEAM MOTOR CARS

| | Taff Vale Ry. Co, | Purrey Steam Cars on Paris-Mediterranean Railway | Serpollet Cars for Würtemberg State Railways | L. & S. W. Ry. and L. B. & S. C. Ry. | Great Western Railway | Purrey Steam Car Paris-Orleans (Sable to La Fleche) |
|---|---|---|---|---|---|---|
| Seating capacity—1st class | 12 | 12 (2d class) | --- | 10 | No division of | --- |
| " 2d class | 40 | 24 (3d class) | --- | 32 (3d class) | Classes | 26 |
| Total | 52 | 36 and 12 standing | 33 and 40 and 8 standing | 42 | 52 | --- |
| Length of carriage body | 45 ft. 0 ins. | 36 ft. 0 ins. | --- | --- | 57 ft. 1 in. | 41 ft. 10½ ins. |
| Width of " (outside | 8 ft. 6 ins. | 9 ft. 5½ ins. | --- | --- | 8 ft. 7 ins. | 9 ft. 9 ins. (inside) |
| Length of 2d class comp. (inside) | 26 ft. 1½ ins. | 15 ft. 8 ins. (3d) | --- | --- | --- | --- |
| " " " " | 8 ft. 11 ins. | 9 ft. 3 ins. (2d) | --- | --- | --- | --- |
| Width of gangways | 2 ft. 8 ins. | --- | --- | --- | --- | --- |
| Height from floor to roof | 7 ft. 2½ ins. | 9 ft. 2 ins. | --- | --- | 8 ft. 2 ins. | --- |
| Wheel base of carriage bogies | 8 ft. 0 ins. | --- | --- | --- | --- | --- |
| " engine " | 8 ft. 6 ins. | --- | --- | --- | --- | --- |
| Diameter of wheels | 2 ft. 10 ins. | 3 ft. 0 ins. | 3 ft. 3.4 ins. | 2 ft. 9 ins. | 3 ft. 8 ins. | 3 ft. 5¼ ins. |
| Total length of car over buffers | 58 ft. 9 ins. | 40 ft. 0¾ ins. | --- | --- | --- | --- |
| Distance between centers of bogies | 40 ft. 9½ ins. | --- | --- | --- | --- | --- |
| Total wheel base | --- | 19 ft. 3 ins. | 13 ft. 1½ in. and 15 ft. 1 in. | --- | 45 ft. 6 ins. | 26 ft. 10¾ ins.* |
| Total weight—empty | 33 tons 2 cwts. | 23.8 tons. | 18.2 tons | --- | 32 tons | --- |
| Boiler—type | Multitubular | Water tube | --- | Multitubular horizontal | Vertical | Water-tube, vertical |
| Diameter | --- | 15.75 ins. (steam drum) | --- | 3 ft. 6 ins. | --- | --- |
| Tubes—diameter | 1¾ ins. | .67 ins. (inside) | --- | --- | 1⅛ in. | --- |
| " number | 312 | 73 | --- | --- | 477 | --- |
| Working pressure | 160 lbs. per sq. in. | 290 lbs. per sq. in. | 256 lbs. per sq. in. | --- | 180 lbs. per sq. in. | 120 lbs.—284 lbs. per sq. in. |
| Fire grate area | 8 sq. ft. | 9.04 sq. ft. | --- | 6.75 sq. ft. | 11.48 sq. ft. | |
| Heating surface—fire box | 39 " | --- | --- | 195 sq. ft. (Water tubes) | 44.34 sq ft. | --- |
| " tubes | 299 5 " | --- | --- | 94 tubes | 625.58 sq. ft. | --- |
| " total | 338.5 " | 280 sq. ft. | 119.5 sq. ft. | 289 " | 669.92 sq. ft. | --- |
| Number of cylinders | 2 | 4 | --- | --- | --- | 4 |
| Engine—diameter of cylinders | 9 ins. | 5.5 ins. and 7.87 ins. | 11.81 ins. | 7 ins. | 12 ins. | 5½ ins. and 7⅞ ins. |
| stroke | 14 ins. | 7.87 ins. | --- | 10 " | 16 ins. | 8 ins. |
| Capacity of coal bunker | 10 cwts. | 617 lbs. (coke) | --- | --- | --- | 400 lbs. |
| " water tank | 530 galls. | 282 galls. | 181 galls. | --- | 450 galls. | 280 galls. |
| Draw bar pull | 4,263 lbs. | --- | --- | --- | 8,483 lbs. | --- |
| Weight per seat | 1,425 lbs. | 1,480 lbs. | 850 lbs. | --- | 1,378 lbs. | --- |
| Cost of car | --- | £1,120 | £1,600 | £1,250 | £1,800 | £3,360 |

* Car has 6 wheels.

TABLE II.—DATA OF PETROL CARS

| TYPE OF CAR | Combined Petrol and Electric Car | Petrol Cars, Pure and Simple | | | | Petrol or Paraffin Car |
|---|---|---|---|---|---|---|
| Name of railway | North Eastern Ry. | Würtemberg State Rys. | Würtemberg State Rys. | Würtemberg State Rys. | Great Northern Ry. | Chemins de fer de la Drome |
| Maker of motor | Wolseley Tool & Motor Co.* | Daimler Co. | Daimler Co. | Daimler Co. | Daimler Co. | Turgan Foy et Cie |
| Number of cylinders | 4 | 4 | 4 | 4 | 4 | 4 |
| Diameter of cylinders | 8½ ins. | --- | --- | --- | --- | 4 ins. |
| Stroke of cylinders | 10 ins. | --- | --- | --- | --- | 4 5-16 ins. |
| Horse-power of motor | 92 \| 100 | 20 | 30 | 70 | 2 motors of 35 h. p. | 16 |
| Speed " " | 400 \| 480 | --- | --- | --- | --- | 800 to 1,000 |
| Diameter of wheels | --- | 3 ft. 3⅜ in. | 3 ft. 3⅜ in. | --- | 3 ft. 0 in. | --- |
| Length of wheel base | --- | 12 ft. 5⅜ ins. | 15 ft. 9 ins. | 15 ft. 10 ins. | 15 ft. 0 in. | --- |
| Overall length of car | --- | 32 ft. 9¾ in. | 36 ft. 1 in. | --- | 33 ft. 6 ins. | 14 ft. 10 ins. |
| " width " | --- | 9 ft. 10 ins. | 9 ft. 10 ins. | --- | 8 ft. 8 ins. | 5 ft. 7 ins. |
| " height " | --- | 13 ft. 1½ in. | 13 ft. 1½ in. | --- | 11 ft. 7 ins. | 9 ft. 1½ in. |
| Seating capacity | --- | 36 | 44 | 52 | 32 | 10 |
| Standing room | --- | 8 | 8 | 8 | --- | --- |
| Total weight empty | --- | 12 tons | 13 tons | 14 tons | 11 tons | 3 tons |
| Weight per seat | --- | 748 lbs. | 663 lbs. | 603 lbs. | 770 lbs. | 672 lbs. |

* The North Eastern Car is provided with a 60 kw Westinghouse generator, direct coupled to the petrol motor

being opened up. Beyond this, other spirits, entirely apart from petroleum, are being made, some of which have exactly the same qualities and have been sold at cheaper prices.

In connection with railway motor cars, the question of mak-

TABLE III.—DATA OF ACCUMULATOR CARS

| Name of Railway | Adriatic Railway Company | Würtemberg State Railways |
|---|---|---|
| Seating capacity of car | 52 | 56 |
| Standing capacity | 16 | 8 |
| Total | 68 | 64 |
| Weight of batteries | 10.45 tons | 8.65 tons |
| Total weight of car, empty | 43.54 tons | 28.3 tons |
| Weight of car per seat | 1,875 lbs. | 1,130 lbs. |
| Number of trailers hauled | -------------- | 1 |
| Weight of trailer | -------------- | 11.3 tons |
| Energy consumed per ton-mile | 37 watt-hrs. by motors | 61.25 watt-hrs. at charging st'n |
| Speed on the level | 37,3 m. p. h | -------------- |
| Maintenance of elecric equipment | -------------- | 2.12d. per mile |

ing coaches as light as possible should be carefully taken into consideration, since the moderate rates of speed employed do not call for a very heavy construction. This is another point in which petrol motor cars are greatly superior to accumulator cars, or to steam cars, their weight, when empty, as will be seen by the weights of the various petrol cars so far constructed, being from one-half to one-third the weight of self-contained electric or steam cars.

TABLE IV.—COMPARATIVE DATA OF SOME STEAM AND PETROL CARS

| Type of Car | Steam | Steam | Purrey Steam Car | | Serpollet Steam Car | Daimler Petrol Car |
|---|---|---|---|---|---|---|
| Where running | Taff Vale Ry. | L.B. & S.C. Ry. and L. & S. W. Ry. | Paris-Mediterranean Ry. | Paris-Orleans Ry. | Würtemberg State Rys. | Wüttemberg State Rys. |
| Seating capacity of motor car | 52 | 42 | 36 | 26 | 40 | 44 |
| Standing room | ------------ | ------------ | 12 | ------------ | 8 | 8 |
| Weight of car empty | 33 1 tons | 30 tons | 23.8 tons | 28 tons | 18.2 tons | 13 tons |
| Weight of car per seat | 1,425 lbs. | 1,600 lbs | 1,480 lbs. | 2,410 lbs. | 850 lbs. | 663 lbs. |
| Fuel consumed per mile | 20.46 lbs. (Welsh) | 8.5 lbs. (Welsh) | 9.58 lbs. (Coke) | *18.13 lbs. (Coke) | 11 lbs. (Briquettes) | .134 galls petrol |
| Cost of fuel, oil, waste, &c., per ton mile | .0535d. | ------------ | .0431d. } Fuel | ------------ | .0597d. | .10d. |
| Cost of fuel, oil, waste, &c., per seat per mile | .0341d. | ------------ | .0285d. } alone | ------------ | .0317d. | .0296d. |
| Cost of maintenance per ton mile | .0442d. | ------------ | ------------ | ------------ | .0223d. | .038d. |
| " " per seat per mile | .0281d. | ------------ | ------------ | ------------ | .0118d. | .0112d. |
| Speed of car alone on level | ------------ | ------------ | 34.2 m. per hr. | 20 m. per hr. | 30 m. per hr. | 24.8 m. per hr. |
| " " on gradient | ------------ | ------------ | 12.4 m. per hr. on 1 in 50 | ------------ | ------------ | ------------ |

Tables have been specially prepared already showing the salient points in connection with the various systems of motor cars treated of in this article.

## BOOK OF "SUGGESTIONS" PREPARED FOR THE CAR EMPLOYEES OF THE PITTSBURG, McKEESPORT & CONNELLSVILLE RALWAY

The Pittsburg, McKeesport & Connellsville Railway Company has recently distributed to its car service men a pocket time record book with blank pages for entering car, route, on, off and hours. With these record pages are eight devoted to "suggestions," which were prepared by J. W. Brown, superintendent of transportation, and which are well worth reading. For instance, the treatment of passengers is discussed in this way:

> A conductor or motorman to be successful must be courteous all the time; it is hard work, but it wins in the end, and when you are compelled to eject a man from the car and have held your temper during the argument with him, you will have the sympathy of every good citizen aboard. On the other hand, if you are irritable, quick to threaten to eject an obstreperous passenger or remind him that you are running the car, you may expect trouble and very little sympathy from the onlookers.
>
> If you carry a passenger past his station, do not get on the defensive at once; admit that you forgot him and say that you are sorry, and nine times out of ten he will forgive you before he gets to his destination. If he threatens to report you, don't say: "I wish you would; my number is so-and-so." The best way to avoid troubles of this kind is not to carry your passengers past their destination.

Other subjects discussed are: Announcing stations, observation of schedule, tending to business, think about your work, loyalty, accidents and the signal system.

## CHANGES IN GERMAN ELECTRIC RAILWAY PRACTICE DURING THE PAST YEAR

BY A GERMAN ENGINEER

Recent changes in the electric railway field in Germany have not been as apparent to the layman as were those which occurred in earlier years. Very few systems have been installed in addition to those previously in operation, for the time has gone by when the words "electric railway" were believed to stand for absolute financial success. Experience has taught that in most German cities with less than 50,000 population an electric railway cannot be conducted profitably, and as the large cities now are well supplied with electric railways, there has been little new work, many companies, in fact, doing no more than to build loops at their terminals to avoid the troublesome switching of trailers. While trifling extensions have marked the limit of what most railways have done within the last year, there has been great activity among the manufacturers of electric railway apparatus toward the development of new traction methods.

When the construction period had been practically completed, electric railway men began to find opportunities for studying the details of their work and to compare their experience with others, thereby learning of many possible economies in operation and of methods for encouraging traffic. That the latter end has been attained is evidenced by the large increase in the number of cars without a corresponding increase in track mileage. In most cases this car increase during the two past years in the industry, which have been far from prosperous, has amounted to from 3 per cent to 4 per cent, but on some large city lines it has reached 10 per cent to 11 per cent. At present many new cars are being purchased to handle this additional traffic, and the experience gained with the old cars is proving valuable in drawing specifications for the new ones.

The new type which, in general, has shown itself best fitted to the conditions met in Germany is a single-truck car equipped with two motors and a short-circuiting brake; furnished with eighteen to twenty seats and having standing room on the platform for ten to sixteen passengers; windows which can be lowered easily so as to have open cars in summer; longitudinal seating; no upper deck, and no glass platform vestibules except on high-speed interurban lines.

Since American practice has become better known, more attention is being given to the interior furnishings. Such substantial woods as bird's-eye maple, mahogany and walnut are used commonly for this purpose. The brass trimmings are now much heavier and more artistic than formerly. Mirror glass is frequently used for the windows, which are allowed to drop on rubber cushions.

The car framing consists almost entirely of German oak, which is stronger and almost 50 per cent heavier than the American variety. It is an ideal building wood, as it can be easily bent and worked. American whitewood is preferred for roof construction. Advertisements are no longer painted on the windows, but are placed on panels running along the car sides above the seats, as is customary in the United States.

Cross seats are popular on interurban lines, as they make riding more comfortable on long trips, but they have proved impracticable on roads having cars less than 2.1 m (6 ft. 10 ins.) wide, as in such cases the seats are too narrow. Where the cars are wide enough, the cross seats are heavy and not easily reversed. In most cases no greater car width than 2 m (6.5 ft.) is permitted on account of narrow streets where the usual distance between the track centers is 2.5 m (8 ft.). The average width of the seats in most modern cars is about 50 cm (19.7 ins.).

Cars with one motor were once quite popular, but two motors per car are used now, although on some large systems a large number of the old single-motor cars are still employed even with trailers. The well-known GE 800 motor is being gradually displaced by motors of somewhat larger capacity, as the addition of the short-circuiting brake has made this necessary. Besides the Sperry brake, the solenoid type has many adherents, but there has been considerable opposition to the introduction of air brakes.

The platforms in all cases are now fitted with channel-iron bumpers which project as much as 40 cm (16 ins.) in front of the dashboard. They have proven very valuable in collisions and have made truckmen less prone to blockade the track, as the latter have learned to their cost that the car is no longer the only vehicle to sustain injury in a collision.

The weight of a car of the type described varies from 7.5 tons to 9 tons, the latter weight being exceptional. American convertible cars have found no extended use owing to their greater weight.

On trail cars, large, easily dropped windows are also preferred because of their convenience in pleasant weather. Many trailers are being fitted with magnetic brakes, thereby saving extra brakemen on interurban lines where more than one trailer is used. It is now realized that the trailers were built too heavy at first. This practice caused much difficulty in switching, and often made it necessary to drag the trailer to the loops at the terminals. The experience thus gained has shown plainly the value of the old light horse cars for trailer work. To overcome this evil, experiments have been made with roller bearings which have shown themselves capable of effecting a saving of nearly 80 per cent in tractive effort. These trials have been confined hitherto to car journals, but it is just as important to build bearings for the motor axle that will always keep the armature in the correct position with reference to the pole pieces. This subject might well be taken up by manufacturers.

When replacing motor gearing a great deal of attention is now being given to seeing that the motor pinion will have as long a life as the gear. Very few railways have approximated this ideal. It is usual to make the gear of ordinary cast steel and to use hardened steel for the pinion. At first the mistake was made of hardening it too much, causing consequent distortion and breakage, but now it is known that the pinion should be of only medium hardness. A life of 40,000 km (24,000 miles) for the pinion is considered satisfactory, although a few large companies have reached 110,000 km (66,000 miles). Car axles are now being made of nickel steel, and axle breakage is a rare event.

Double-truck cars are not likely to be built frequently, because they are too large for German street conditions, and single-truck cars with trailers are cheaper and more flexible. A double-truck car with twenty to thirty seats weighs approximately 12 tons when carrying about forty passengers, while a single-truck car weighing only 8 tons carries thirty-three passengers. The former increases the power cost, a serious matter in Germany, where many of the companies are obliged to buy current from 10 pfg. to 15 pfg. (2½ cents to 3¾ cents) per kw-hour. On the basis of weight alone, therefore, the double-truck car causes an increase of 50 per cent in the power expense.

Quite a number of railways have placed wattmeters on their cars. Most of them report a considerable saving in current since their installation. At first the cost and possible unreliability of the instruments were feared, but as it was found that they were usually accurate within 4 per cent during four to six months service and had an excellent influence on the amount of current used by the motormen, many companies hastened to install them. On several large systems their use on cars has become standard, and has made it possible to study the distribution of power more clearly than ever before. Some companies have found, incidentally, that the motorman who uses too much current is deficient in other respects, but others have found that an otherwise capable motorman will use excessive current. The wattmeters unmounted cost from $25 to $40 each.

The increased attention now given by railway managers to the details of operation has shown the necessity for a uniform system of accounting so that the cost of similar items may be easily compared. A committee of the International Tramways and Light Railways Association has this in charge, and a report, which was published in the Street Railway Journal for Sept. 10, was submitted at the Vienna convention. Of course, no one is compelled to use the standard form, but many will do so on their own initiative.

The habit of continually reducing fares has now, fortunately, ceased, and has been replaced by the opposite tendency on the part of those railways (especially the municipal ones) who are free to do as they please. At one time it was feared that the municipal lines would lower their fares to ruinous figures, but as a matter of fact when a private company now desires to increase its fares, it often justifies its course by pointing out that some municipal line operating under like conditions is charging higher rates. The municipal lines have raised the single and commuter fares, whereas the private lines usually increase commuter fares only. The question of commutation tickets is now receiving considerable attention because of the large percentage of such traffic, usually 15 per cent to 20 per cent, and in a few cases 30 per cent to 50 per cent. This business was formerly treated as a side issue, but now that it has reached such proportions and millions of passengers have been carried at less than cost, the railway companies are seeing their mistake, though rather late, as the public has become used to very low fares.

Transfer traffic has been encouraged since it is recognized to be of mutual benefit where reasonable fares are in vogue. More attention is being given, however, to the control of transfers. New tickets have been devised, requiring the passenger to transfer at some definite point which will bring him to his destination in the shortest time. The discussions on this subject at the recent Vienna meeting of the International Tramways and Light Railways Association showed that it is one of widespread interest.

There is a growing tendency to sub-divide the management of operation by appointing such special officials as inspector of stopping places, of switches, of track cleaning, etc. This indicates to what extent German railway managers are looking after the details of their systems.

The efforts for tieless street railway construction have reached a definite point since it has become known after long and expensive experiments that concrete, which is becoming used more and more throughout German cities, forms a good base for the track, but only under the following conditions:

1. The rails must not rest directly on the concrete, but upon an intervening layer of asphalt concrete about an inch thick.

2. The concrete must have sufficient time to harden. This does not mean three to eight days, but three months, which, under regular traffic conditions, is too long a time to wait.

Hence the concrete sub-structure of to-day does not fulfil the necessary conditions.

"Asphalt concrete" is prepared by mixing asphalt or similar material with concrete and a little sand. The combination is then tamped like gravel. From the viewpoint of the railway companies alone, the best roadbed is that built like a Telford pavement, viz.: with a layer of stones, 25 cm to 30 cm (10 ins. to 12 ins.) in height, set on end, and covered with gravel to a depth of 10 cm (4 ins.). Special attention is devoted to drainage, and the use of drainage conduits connected with the rail grooves consequently is increasing.

There are still varying opinions in the matter of using single-tongue or double-tongue switches, but this is probably due to the fact that the adherents of double-tongue switches have failed to take the trouble to examine carefully the operation of single-tongue switches where they are in constant use. The single-tongue switch has qualified throughout and the cost of its maintenance is negligible as compared with a double-tongue switch. It has won the victory because it is lower in first cost, cheaper to maintain, easier to operate and is less likely to stick or fail on account of mud and ice. It guides the wheel better than a double-tongue switch which is not kept in perfect condition. This follows from the fact that both tongues are never laid so accurately as to have the first pair of wheels touch them simultaneously. Even if this were possible, trouble would arise because the gage distance between the wheels of the various cars on the same system is not exactly the same. But why maintain a second tongue at all when it seldom or never operates?

The rails now coming into general use are much harder than the earlier ones, the usual strength adopted being 75 kg per sq. mm or over. The "blattstoss" or mitered rail joint appears to be better suited for these harder rails than for soft rails. The "fusskremplasche" or continuous rail joint is employed almost universally on new work or improvements of old track. With reference to welding, it may be noted that the Goldschmidt "thermit" process has been applied successfully on several large systems. A new electric welding method is that of Melaun, which has met with approval thus far, but, of course, no certain data on its value can be available for some years to come.

Rail lengths vary from 10 m to 12 m (32 ft. to 39 ft.). The "Phœnix" rail, weighing from 42 kg to 53 kg per m (84 lbs. to 106 lbs. per yard), is most largely used, but the "Haarman" girder rail has found some adherents, particularly for interurban work.

The capacity of the power stations has been increased in proportion to the heavier traffic, but few extensions have been made, as the original structures usually were large enough to take the additional units. A considerable part of the increase in street railway capitalization may be placed to this account.

Contrary to American practice, the results with very large generating sets have not been of the best. Units of 1000 hp to 1500 hp have proved the most economical for large stations—not those of 2000 hp to 3000 hp, which are not much better in coal economy and are more difficult to handle. The reasons for this difference from American practice may be found in the lower wages and higher cost of coal in Germany. There are a few stations, however, having units over 1000 hp.

Practically all of the power stations in Germany are now equipped with storage batteries. No other development in power station work has saved so much as this. In small stations this item alone actually has effected a coal saving of 25 per cent to 30 per cent. Practically all stations are now furnished with feed-water heaters and purifiers. The use of inferior fuels such as garbage in connection with automatic firing has increased and is showing good results. Liquid lubricants are gradually displacing grease. Grease compounds are also going out of use for gear lubrication.

An important event in street railway circles during the last year was the transfer of the executive offices of the German Street Railway and Light Railway Association from Hamburg to Berlin. After the death of President Roehl, the members of the Verein decided unanimously to remove their headquarters to Berlin. From Berlin are controlled, reckoning according to income, one-fourth of all German street railways and more than three-fifths of all light railways. This change will also make it possible to make better use for legislative purposes of the vast amount of information gathered by the members. Officers for different lines of work are elected by the society for periods of six years.

One of the most valuable results of the last year has been the compilation of uniform statistics for all German street and light railways. In Prussia these statistics are divided into two parts, one covering the work done by the government and a second part by the Verein. The rest of Germany is looked after by the Verein alone. These statistics have been found to be very valuable for all the railways and authorities connected with street railway affairs, and have had an important influence on railway accounting.

The sentiment in Germany in regard to fenders is distinctly unfavorable on the part of both the railway companies and government officials. In some cities their installation is forbidden on the ground that they increase accidents instead of diminishing them. The press is also taking a more liberal view of the rights of railway companies, and its comments on accidents and similar events are now more just than formerly. Probably the principal reason for this is the frank publication of accident statistics and the public discussions of street railway affairs by the Verein in the presence of members of the press. Apparently the latter now prefers to devote to automobiles that aggressive attention which was formerly given to the street railways.

Considerable progress has also been made in improving the condition of employees. Many of the traction companies are members of a benefit fund organization called the "Vereins Deutscher Privat-Eisenbahn Verwaltungen" (Association of German Private Railway Managements), which supervises the distribution of pensions to the widows and orphans of deceased employees, provided their period of employment has exceeded a given time, say five to ten years. Some companies also, as in Berlin, Hamburg and München, have separate funds managed in conformity with the government regulations. The cost is borne equally by employer and employee. In addition to these, there are numerous funds throughout the country for loaning money to workmen without interest or even making gratuitous payments to deserving employees suffering financial distress on account of illness in their families or some other misfortune.

Another innovation during the last year has been the construction of model dwellings for railway employees. This is done either by the railway company itself, which is the sole manager in such cases, or by co-operative building societies formed by the employees and assisted financially by the company. In the latter case, only a part of the executive committee is chosen by the company, but it is customary to have one of the company's officials act as chairman.

These model houses are very popular, as the rents are lower, the rooms larger and better ventilated and their general appearance superior to other buildings in the vicinity. Each house usually contains three or four large rooms, a bath room, kitchen, closets, cellar, etc., together with a yard. The universal rule is that the tenant must vacate the premises upon leaving the service of the company. Such conveniences as these, which are not found to so great an extent in other industries, are well suited to make the employees contented. The ownership of a neat home tends to keep a man there during his leisure time and naturally raises the standard of family life among the working classes.

Some companies accept savings from their employees in amounts up to 5,000 marks ($1,250), paying thereon interest equivalent to their dividend rate, but never less than 4 per cent.

All of the changes hereinbefore mentioned have not been without their effects. One of them has been a reduction in operating expenses on many lines, and although the dividends have not always increased, they are now on a sounder basis, which, in the end, is most advantageous to the stockholder.

Destructive competition between railways covering the same territory has become a rarity, the rule now being co-operation, especially with reference to fare adjustments. As noted before, there have been many changes in commutation rates, but few in regular fares.

The municipal ownership question has cleared considerably during the last year. It is true that some municipal lines have demonstrated that they can give as good service as a private corporation, but the public was disagreeably surprised when it became evident that the municipalities were just as anxious to earn large profits as any other business concern. Quite a number of municipal lines are operated at a deficit, which must be covered by the taxpayers. It is pleasant to record that despite the agitation on this subject, the officials of both classes of railways are working together harmoniously on all technical questions.

There has been little new railway legislation during the past year, but efforts are being made by the traction companies looking toward more just liability laws, particularly with reference to property damages. Under present conditions a railway company is held liable for damages in a case, for instance, where a mother with a child in arms jumps from a moving car in spite of warnings from the car crew. If the child is injured, the judge says that according to the letter of the law the child was not guilty of contributory negligence and the company must pay damages even though it be admitted that the employees of the latter did all they could to prevent the accident.

The experiments of the Studiengesellschaft für Elektrische Schnellbahnen have ended. They have demonstrated that it is possible to attain 210 km (126 miles) an hour, but also that so high a speed is not commercially practicable under present conditions. All reports regarding a 280-km (168 miles) high-speed electric line between Berlin and Hamburg are without foundation. No one is thinking seriously of such a project. However, the proofs that such high speeds are possible has led the Prussian and Bavarian State railways to experiment with locomotives using superheated steam. These have attained 140 km (84 miles) an hour with five cars, but higher speeds than this, although regarded possible, were not attempted.

## BLUE PRINTING AT THE TWIN CITIES

The use of blue printing machines has of late found much favor among manufacturing companies and engineering concerns whose work necessitates the printing of great numbers of drawings in all sorts of weather, but it has only recently been taken up to any extent in the electric railway field. One of the most interesting features of the new offices of the Twin City Rapid Transit Company in Minneapolis is a blue print room capable of turning out from 200 to 300 24-in. x 36-in. drawings a day. At first sight there would seem to be no special need for such facilities on an operating road located in a large city where photographers of all kinds are numerous; but when it is realized that sometimes hundreds of new prints are necessary in issuing specifications to contractors, the importance of being able to turn out uniform work, regardless of the weather, becomes apparent. Then, too, rush prints are often needed in the regular construction work of a road, and if the favor of the sun has to be sought each time, there is frequently a chance of serious delay, costing far more in the end than the $400 or $500 which might well be spent for blue printing equipment.

In the Twin City offices the blue print room is located on the third floor of the building, near the offices of the electrical engineer, architect and purchasing agent. Instead of being in some inaccessible pent house on a windy roof where tracings and prints are exposed to the elements, soot, dirt and dust, the print room is as convenient as any other office, and the chances of spoiling valuable tracings are greatly reduced. The room is about 39 ft. long x 17 ft. wide, a store room 7½ ft. x 12½ ft. being taken out of one corner. The printing is done on a Williams, Brown & Earle machine, five enclosed direct-current arc lamps furnishing the light. Each of these lamps is a General Electric form 8, 110-volt 7-amp. light, the carbons of each being surrounded by a clear glass globe. The lamps are run off the 110-volt lighting circuit of the building, which is supplied from a motor-generator set by 600-volt trolley current. The voltage at the arc runs from 80 to 85, the longer or upper carbon being ½ in. in diameter and 12 ins. long, while the lower carbon is of the same diameter, but 5 ins. long. The lamps are hung by long S hooks of iron wire from the frame of the machine, which is made of wrought-iron pipe.

The rollers which feed the blue prints and tracings across the illuminated field of the lamps are driven through worm gears and belting by a two-pole 1-10-hp motor making 1500 r. p. m. The motor also takes current from the 110-volt lighting circuit. The end of the motor shaft is fitted with two pulleys, one or the other of which is belted to one of two pulleys on a horizontal shaft carrying twelve pulleys of varying sizes at its other end. These twelve pulleys connect with twelve others on a shaft carrying a worm at its other end. The worm wheel drives a couple of spur gears which are fastened to the shafts carrying the rollers that feed the tracings and blue print paper forward. Twenty-four different speeds are thus available in the machine, to suit different styles of tracings and qualities of sensitized paper. When a print is made it passes into a galvanized iron box at the bottom of the machine, with the tracing. The illuminated field is enclosed by reflectors, which are darkened on the outside so as to keep the light where it is most needed, and a quick break snap switch is provided for each of the five arc lamps, so that the amount of light given out may be regulated, as well as the speed of the paper. These switches are mounted upon a slate panel that is attached to the frame, as is the motor, which likewise has a snap switch of its own. A double-pole single-throw knife switch cuts off the entire current supply of the machine, and suitable cartridge fuses are mounted on the back of the slate panel. In another corner of the room, which has a concrete floor, is a double washing tank lined with galvanized iron. This tank is about 8 ft. long x 4 ft. wide, and above it are run wires which carry drying prints so that the drippings may be properly drained. The blue printing machine takes up but a small part of the room, and so successful is its operation that no sun prints are now made by the company, all the blue prints for the system being made by electric light in this room by a boy who operates the machine. The facility with which work is turned out is an object lesson to the street railway man who tries to make prints on cloudy days by natural light, and the experience in Minneapolis justifies the attention of the technical staffs of many other roads.

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The employees of the Dayton, Covington & Piqua Traction Company were recently treated to a rather novel outing by Edward C. Spring, general superintendent of the company. One day half of them made a run to Cincinnati over the Cincinnati, Dayton & Toledo Traction Company's line, and the following week the others went to Columbus over the Appleyard system. Both runs were made on the Dayton, Covington & Piqua Company's cars, and the men spent several hours in sight-seeing and familiarizing themselves with other roads.

# THE VIENNA CONVENTION OF THE INTERNATIONAL TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION

The convention of the International Tramways and Light Railways Association, which was held in Vienna, Sept. 5 to 8, was one of the most interesting in the history of the association, not only on account of the discussions and papers, but also for the entertainments and trips which were enjoyed by those in attendance. More than 350 representatives of different nations in Europe participated in the meeting, and an official aspect was given to it by the presence of governmental representatives from Germany, Austria, Belgium, Bulgaria, Spain, France, Greece, Hungary, Italy, Roumania, Russia and Switzerland. Altogether there were thirty-four officials commissioned by their respective governments to attend the convention.

At the opening session there was also a large number of Austrian governmental officials and representatives of the municipal government of Vienna, among them the Austrian Railway Minister, Dr. von Wittek; the Mayor of Vienna, Dr. Lueger; the Governor of Lower Austria, Dr. Pattey; the president of the Chamber of Commerce, etc.

In this opening session, Mr. Janssen, as president of the International Association, thanked the government and municipal representatives present for honoring the meeting with their presence. The Railway Minister, von Wittek, in replying, assured the delegates of the great interest which the Austrian Government took in their association. The Mayor of Vienna then welcomed the delegates to the city, first in his capacity of Mayor and then as chairman of the Municipal Tramway Board. After an address delivered by the president of the Chamber of Commerce of Lower Austria, and one by the president of the Austrian Association of Engineers and Architects, President Janssen offered the chair during the first session to Mr. E. A. Ziffer, president of the Bukowina Railway Company.

The association then proceeded to discuss the first question, which was on methods of protecting trolley wires from falling telephone, telegraph and other aerial wires. The paper on this subject was by Mr. Petit, chief engineer of the Société Nationale des Chemins de fer Vicinaux of Belgium. He stated in the first place that all tramway engineers are unanimous in the opinion that all the protective methods used at present to guard against danger from the fall of telephone and telegraph wires on trolley wires are very imperfect; and that such changes and alleged improvements which have been made up to the present in these systems have only complicated them without securing any satisfactory results. On account of this fact, which is generally recognized, the speaker believed that the discussion should not be directed upon whether any one system is more or less efficacious than another, but whether some method cannot be adopted for disposing entirely of these protective devices, or at least of reducing the necessity for their use to the strictest minimum. He stated that the best solution would be to put the telephone wires under ground, a method which has been followed in many large cities, notably in Vienna. He then discussed the question whether the expense of installing the protective devices should be borne by the telephone or tramway interests. He believed that the owners of the low-tension lines ought to assume a part of the responsibility of the situation created by the proximity of their wires to the high-tension wires, and that the cost of the installation of the protective devices ought to be divided between the owners of the two installations. There is no doubt that if such a rule were enforced the public authorities would be less disposed to insist upon the tramway companies making continual changes and adopting all sorts of ridiculous protective devices.

Mr. E. Gerard, chairman of the Railway Department of Belgium, discussed the history of the method of defraying the cost of these protective devices. He referred to the early American legal controversies between the street railway and the telephone interests before the former secured the right to install overhead electric wires. He then mentioned the English decisions, particularly that in Leeds, in which it was decided that as the streets were originally dedicated to transportation, the telephone companies used them only on sufferance, and that they ought to be responsible for any accident caused by the fall of the telephone wires. He also pointed out the inconveniences which would be adopted if the theory of the first occupant was maintained, and believed that as the telephone and tramway companies have a common interest they should divide the necessary expense of installing these devices. It is the best plan not to attempt to stand in the way of progress, but each side should make concessions.

Mr. von Leber, of Vienna, counsellor to the Austrian Railway Ministry, then discussed the system of protection which has been used in Vienna and on other large Austrian systems. The attempt is made to put the telephone systems under ground as far as possible; where overhead crossings are necessary, two systems of protection are used. One consists of a wooden cover on the top of the trolley wire, the other is a grounded metal guard bar or ring placed near the pole and several centimeters below the telephone wires. When a wire breaks, one part comes in contact with this earthed guard and the other part with the trolley wire. The result often is that the trolley wire melts at the point of contact with the earthed guard, increasing the danger. To obviate this the telephone authorities now surround the telephone wire with a copper sheath at the point where it would come in contact with the guard, the object being to cause the wire to melt at its point of contact with the trolley wire. This system has been employed in Austria for a number of years and has given very satisfactory results.

Mr. Roosen, chief engineer of telegraphs in Belgium, said that the ideal solution was, of course, the burial of the telephone wires. This could be done only in cities of the larger size, and in smaller cities aerial circuits had to be run. He added that an underground telephone system was liable to electrolytic troubles, as had been shown on a number of occasions with the telephone system in Brussels. In his opinion, the best protective system was that consisting of guard wires connected to earth, such as had been specified by the Board of Trade and which had been installed by many tramway companies.

Mr. Munch, counsellor of the Postal Department of Berlin, agreed with the conclusions of Mr. Petit, and stated that in Germany the Telephone Department installed underground wires as far as possible.

Mr. Pedriali, of the Brussels Tramways, replied to the statement made by Mr. Roosen on the subject of the electrolytic destruction of telephone cables. He stated that up to the present time there had been no proof that any electrolytic troubles noticed on these cables were due in any way to the railway current. He then discussed the earthing of guard wires, and criticised certain requirements in the recent rules of the Board of Trade, especially that on the maximum distance permitted between the guard wire and the trolley wire.

After several other remarks presented by Messrs. Köhler, of Berlin, and Grialou, of Lyons, the association voted unanimously to adopt the following resolutions, which were those proposed at the conclusion of his paper by the speaker, with the exception of a slight amendment in the second paragraph of conclusion 5:

1. No protective device guarantees absolute security, either for perfect telegraphic and telephonic service or from accidents to which the public is exposed.

2. It is desirable to diminish the chances of contact between low-tension wires and trolley wires, and to this end a reduction in the number of aerial crossings between the two systems is desirable.

3. To this end, alteration in the position of the low-tension wires is justifiable from the fact that in the great majority of cases the direction followed by these wires can be easily changed.

4. It would be equitable if the owners of the high and low-tension lines should each adopt measures to avoid the breakage of wires and consequential accidental contact, and the expense of adopting all protective devices should be divided between the two services instead of being borne exclusively by the tramway companies.

5. Where the authorities insist on certain construction, their requirements should be definite, so as to avoid changes from existing protective measures to others which require considerable additional expense and a radical change in the existing conditions of the aerial lines. Where a tramway company has been required to install such protective devices according to the city specifications, it should be relieved of further expense therefrom in the future.

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TUESDAY'S SESSION

The second session was presided over by Mr. Spängler, the manager of the municipal tramway system of Vienna.

Mr. Haselmann, manager of the Chemins de fer Vicinaux of Aix-la-Chapelle, presented a report which he had prepared on renewal and amortisation funds. He spoke of the great interest which this subject possesses to tramway companies, and remarked that in spite of all of the difficult problems which its solution involves it had been settled in a satisfactory manner by the steam railroad companies for over thirty years. The main difficulty in the problem was the establishment of a satisfactory basis upon which the various payments to the fund should be made. All the factors which affect the life of the apparatus employed have to be taken into consideration. The annual payments to the renewal fund should be such that at the end of the service the sums paid in, with the interest, should be equal to the cost of renewing the apparatus, diminished by the sum which should be secured by its sale as old material. It is difficult to establish a fixed percentage for all parts of the equipment, for one installation varies from another, depending upon different local conditions. It is, however, possible to establish a basis for all important parts when the local conditions are considered. When this basis is better fixed it will be more easy to compare the results of operation in different enterprises. He proposed the appointment of a committee to report at the next convention and select bases upon which renewal fund payments should be made.

Mr. Micke, manager of the Berlin Tramways, remarked that the subject had already been considered at length by the authorities, but owing to the great difficulty of reaching a satisfactory conclusion there had been no German legislation on this subject except for the track and rolling stock of companies operating over their own right of way. He stated that a committee such as had been proposed had been appointed by the German Street Railway Association and was now at work upon the subject. He suggested that it would be better to await the report of this committee and place the subject on the programme of the next International convention. He thought that the report of the German Association would assist in determining the proper solution of this question.

Mr. Piecke, manager of the Allgemeine Lokal und Strassenbahn Gesellschaft, of Berlin, seconded the motion of Mr. Micke.

Mr. Lavalard, of the General Omnibus Company, of Paris, also seconded the suggestion of Mr. Micke. He remarked that a satisfactory solution of this question was desired by all the French companies. At present the municipalities in France which are interested in the net receipts of the French tramway enterprises often refuse to accept the basis of the renewal fund payments made by those companies.

Mr. Ulbrich, delegate from the government of Saxony, asked whether, in this study of the question which was being made by the German Street Railway Association, any consideration was being given to the continuous changes in the art, which often oblige a tramway company to replace certain of its apparatus before it had actually worn out.

Mr. Köhler, manager of the Berlin Tramways, recognized the importance of this remark, but he believed that the tramway companies took this matter into consideration in their amortisation fund, which ought not to be confused with the renewal fund.

After several remarks by Messrs. Janssen, Géron and Pétri, the motion of Mr. Micke that the subject should be discussed at the next meeting, after hearing the results of the investigation by the German committee, was adopted unanimously.

The president then called upon Mr. Vellguth, secretary of the German Tramways and Light Railways Association and member of the committee on transfers, to present the committee report on this subject. This report was published in the Street Railway Journal for Aug. 6, 1904.

Mr. Vellguth's report did not attempt a complete solution of the question of issuing transfers, especially for large companies. This, however, was not the fault of the committee, as only two large companies, those in Paris and Lyons, responded fully to the list of questions. Information was requested from America on the systems of control in use, but the information received was, unfortunately, so meager that the committee was not able to give any extended information in regard to this branch of the subject. Mr. Vellguth then presented the report, in which he discussed the different systems in use. He closed by defining the classes of companies for whom a transfer system is of advantage.

Mr. Köhler, of Berlin, stated that in a recent trip to the United States he had been surprised to see the extent and character of the transfer system used by the large companies. He had been especially astonished because during a preceding trip several years ago the managers of one of the largest companies had told him that they were opposed to the transfer system. The extension which had occurred since then was due, it seemed to him, to the demands of the authorities. Their requirements had not been followed with satisfactory results to the companies; for example, on the Chicago system, the system of transfers had increased the total traffic by only 1¼ per cent, while the number of transfers issued had increased 40 per cent. He concluded by declaring that a system of free transfers was undesirable for large tramway companies.

Mr. Spängler, of the municipal tramways of Vienna, called the attention of the association to a new system of transfer tickets which had been introduced in Vienna, by which it was only necessary to punch the ticket twice, whereas four punches were formerly necessary. This new type of ticket, which was illustrated and described in the Street Railway Journal for Aug. 27, has been in use for a number of weeks only, and has given very satisfactory results, except that the bright red surcharge on the ticket has tired the eyes of the conductors. This color will be changed to a softer tone.

As Mr. Pavie, manager of the Compagnie Générale Française de Tramways, was not able to attend the convention on account of illness, his paper on the use of trail cars was submitted for discussion. This paper was published in the Street Railway Journal for Sept. 17, on page 399. After a discussion in which Messrs. Vellguth, Thonet and Petit joined, the following resolution was unanimously adopted:

> The association considers any prohibition unwise that limits companies to a single trail car, except in special cases, such as steep grades, experience having shown that the use of two cars and even, in some cases, three cars, does not present any drawbacks, provided always that the motor cars are equipped with effective brakes and sufficient capacity of motors.

Mr. Fromm, of Hanover, then presented the paper by Mr. Klitzing, on "Economy of Current in Electric Railway Operation." An abstract of this paper was published on page 323 of the Street Railway Journal for Sept. 3. Mr. Klitzing first referred to the difficulty of comparing the current consumption of cars on different systems, owing to the large number of factors which affect the result. He then showed the great importance of reducing the consumption of current to a minimum. The methods of handling the cars by the motorman should be given the closest scrutiny. To secure this result, many companies have equipped their cars with wattmeters, which enables them to differentiate the economical from the wasteful motormen. He recommended that the subject be further discussed at the next meeting.

Mr. Thonet, of Liége, said that if the subject was taken up at the next meeting it would be advisable in the meantime to make a special study of the different kinds of wattmeters employed, as well as of the different systems of prizes offered for economical use of the current.

Mr. von Pirch, of Elberfeld, stated that he had equipped all of his cars with wattmeters, and the results had exceeded his anticipations. The economy realized had been only 3 per cent, but the car speed had increased 4.8 per cent during the week and 6.8 per cent on Sundays. He estimated that with normal conditions the economy of the current which will be realized by the use of wattmeters on the cars will be not less than 10 per cent.

Mr. Ulbrich, official delegate from Saxony, called the attention of the association to the fact that the offer of prizes for the economical use of current has certain disadvantages from the standpoint of safety. In order to economize current, motormen will descend grades at a high rate of speed and take other chances. This had been the experience of the steam railroad companies when they had established prizes for the economical use of coal among firemen.

Mr. Pedriali, of Brussels, although recognizing the advantages of the use of wattmeters on motor cars, stated that on certain systems it was somewhat difficult to get satisfactory comparative results from them. For example, in Brussels the grades, and consequently the consumption of current, vary greatly; moreover, during the day each car is operated by three different motormen. The speaker stated that his company employed special inspectors to watch the motormen, and upon their reports the prizes were given.

Mr. Björkegren, of Berlin, stated that in Berlin, although the cars are also operated by three different sets of men during the day, it has been possible to overcome the obstacles mentioned by Mr. Pedriali. After each trip the conductor takes down the reading of his wattmeter and puts it on his trip card. The average consumption of current of each motorman is then compared every fifteen days with the average consumption of all the motormen operating on that line, and it is very easy to determine which are the most economical of current. The use of wattmeters also determines whether the equipment is in good condition. After some further remarks by Mr. Fromm, it was decided to continue the discussion at the next meeting of the association.

Mr. Géron, of Brussels, then presented the report on the standard form of monthly operating report, which was published in the Street Railway Journal for Sept. 10. The report on this subject was divided into three parts; the first was devoted to replies to certain companies relative to the proper classification of accounts which had come up since the London convention; the second discussed the choice of units intended to facilitate the comparison of operating results; finally, the speaker presented the standard form of monthly report. As regards the questions raised at the London convention on the proper classification of different accounts, the speaker stated that according to the opinion of the committee, the price received from the sale of old material should be credited to "Account IV., Expense of Operation," or else to "Account II., Amortisation and Depreciation;" that the payments intended for the establishment and maintenance of the renewal fund ought to be made to "Account II., Amortisation and Depreciation;" finally, that taxes and car licenses ought to be charged to the sub-accounts of "Primary Account 8, General Expenses." The speaker explained the reasons of the committee for these decisions, and stated that they had been followed by the various companies which have adopted the standard system of accounting. Referring then to the units of comparison, the speaker was of the opinion that the car-kilometer ought to be maintained, although this unit should be explained by other statistical information contained in the operating report. Mr. Géron then passed to the principal part of the report, the standard form. He pointed out the advantages which all European street and interurban railway companies would gain by the general adoption of a standard form of report. He closed by expressing the wish that this form would receive as favorable a reception on the part of the tramway companies as that given to the standard classification of accounts which had been presented in London, and which in less than two years had been adopted by more than fifty European tramway companies. He was persuaded that the monthly form of report and the standard classification of accounts recommended in London covered all the principal questions of operation, and he hoped that the association would approve the report as recommended.

Mr. Lifka, of Vienna, stated that the municipal tramways of that city had adopted the London classification of accounts and that the results had been very satisfactory. He was happy to take this occasion to testify to his high appreciation of the work of Mr. Géron and his associates, and to thank them, in the name of the tramway companies who had adopted the London classification, for the pains which they had taken to prepare this report. As far as unit of comparison was concerned, Mr. Lifka criticised the car-kilometer and preferred the passenger-kilometer. He concluded his remarks by expressing the hope that the classification of accounts and the form of report would permit the International Association to compile a great deal of statistical information relating to roads, such as had been proposed by Mr. Ziffer as long ago as 1887, at the time of the first meeting of the International Association in Vienna.

Mr. Vellguth, of Berlin, advocated the use as a basis of comparison, the kilometer of line, a unit which had been introduced into the German statistics and was required by the German Association. He requested that the monthly form proposed by Mr. Géron should not omit this unit, which was most important in establishing the value of any line or of any tramway system.

Mr. Géron stated that the monthly report had in view only a comparative statement of the results of operation, and that in this case the most logical unit of comparison seemed to be the car-kilometer. He acknowledged that the kilometer of line was a very desirable unit for comparing the earning power of tramway companies.

Mr. Vellguth argued that in that case the monthly report ought not to omit such an important factor, as it was a gage of the intensity of traffic.

Mr. Géron replied that the tables in the monthly report did not permit of a full statement of all the data on an electric railway. He added, however, that it was easy to take these local circumstances into consideration if there was any need of using a coefficient of traffic-density, which ought to be uniform for each system.

Mr. Kakujai, of Buda-Pest, thought that it was not only necessary to have the principal accounts in the standard form of accounts uniform, but the reports should be uniform in all other points, as, for example, in charging of certain expenses to one account or to another. The comparisons of the results of operation would be most complicated unless one expense should be charged always to the same account. He thought that it was especially necessary to distinguish in the clearest possible way the charges concerning operation from those devoted to renewals.

Mr. Géron recognized the importance of this remark, which would be an object of careful consideration on the part of the association.

After other remarks and demands for information by Messrs. Grialou, of Lyons, and Thonet, of Liége, the association adopted unanimously the following resolution:

The association, after having heard the report presented by Mr. Géron for the committee on the standard form of report, approves the conclusions and recommends the adoption and general use of the classification of accounts and form of monthly operating report proposed by the committee.

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WEDNESDAY'S SESSION

During the third session the chair was occupied by State Counselor Pérouse, chief of the French Government Department of Railways.

The first paper presented was that on systems of current distribution for electric railways, by Mr. Pforr, engineer of the Allgemeine-Elektricitäts-Gesellschaft, of Berlin. This paper was published on page 333 of the STREET RAILWAY JOURNAL for Sept. 3.

Mr. Petit, of the Société Nationale des Chemins de fer Vicinaux, of Belgium, said that the best equipment for light railways was a difficult question, not only because the traffic consists of heavy trains which are hauled long distances, but also because of the irregularity of the service. His company had recently converted one of its lines to electricity, and after a careful examination had decided to use the Winter-Eichberg single-phase system.

Mr. Köhler remarked that the principal question was whether it is possible to operate electric cars or trains within the city limits at low voltage, and outside those limits at high voltage. He asked the speaker for information on this point.

Mr. Pforr replied that this question was now being considered by the Allgemine-Elektricitäts-Gesellschaft, and that while he could not enter into details, he was able to state that the company regarded the problem as completely solved. Within several weeks an experimental line would be completed near Berlin, where an electric car would be in operation on a line, one section of which would be supplied with direct current and another section with single-phase alternating current.

Mr. Krizik, of Prague, believed that the possibilities of direct-current distribution have not yet been fully utilized. He cited particularly a line recently built by him between Tabor and Bechyne; this line has a length of 24 km, and is equipped with the three-wire system. Direct current is used with a tension of 1400 volts between the outside conductors, while the rail serves as the middle wire. The power station is at one end of the line. Mr. Krizik then discussed the advantages of this system, one of which was that if one side of the circuit broke down the line could still be operated from the other side of the circuit. He also said that the system permitted the use of a low voltage inside of the city and a higher voltage outside. He concluded by stating that he was at this time constructing a railway on the three-wire system, on which an 800-hp locomotive built for a voltage of 3000 volts direct current would be used.

Mr. de Burlet, manager of the Société Nationale des Chemins de fer Vicinaux, of Belgium, then discussed track construction for interurban steam lines. He said that cheap construction of track was poor economy in the long run, and made a strong argument in favor of substantial track construction.

Mr. Luithlen, general inspector of the Austrian railways, then presented his report on the advantages and disadvantages of electric traction for light railways. This report was published on page 293 of the STREET RAILWAY JOURNAL for Aug. 27. As shown by the report, the principal advantage of electric traction for this class of service is an increase of gross receipts, and while the operating expenses are also larger, they increase in a less ratio than the gross.

The final paper discussed at this meeting was an elaborate report on motive powers by E. A. Ziffer, president of the Bukowina Railway Company. In his report, Mr. Ziffer considered all of the motive powers used, not only on the Continent, but abroad, including steam, gasoline, gas, alcohol and electricity. The principal advantages which all motor cars possess over regular steam locomotive operation is in the more frequent service and decrease in expenses on lines of light traffic. The writer referred particularly to a steam motor car of 100 hp, manufactured by Ganz & Company, which was completed and put in operation only within the last days of July. The equipment of this car includes two 50-hp engines, each connected to a separate axle. According to experiments, this car, which weighs 23 tonnes, was built to mount grades of 0.67 per cent at a speed of 72 km per hour, and on a level to maintain a speed of 95 km an hour. The average consumption was only 2.2 kg of coal and 22 liters of water per kilometer. According to Mr. Ziffer, steam possesses a number of advantages over other motive powers and offers the greatest security. Gasoline cars, as compared with steam cars, have the advantage of requiring a less skilled attendant. The mechanism of these cars, however, is very complicated, and their power is limited. Alcohol cars are still in the experimental stage, although possessing some theoretical advantages. Passing to electric traction, the speaker stated that since the London congress electric traction by accumulators has practically disappeared, and those companies which were operating accumulator cars have either abandoned their use or are planning to do so. He then discussed the latest developments in electric traction, such as single-phase work and high-tension direct-current work, and finally referred to the mixed system used on the North Eastern Railway of England, on which a gasoline motor drives a generator which furnishes current to the motors geared to the car axles. Mr. Ziffer stated that the expense of operation of motor cars varies according to the power employed and other local conditions, but averages from 20 centimes to 25 centimes per kilometer, or about half that of locomotives.

Mr. Fogowitz, chief engineer of the Lower Austrian railways, described the Komarck motor cars used on that system, and to which Mr. Ziffer had briefly referred. These cars are of 30 hp and weigh 7 tonnes empty. They can mount a grade of 2.5 per cent, of 8 km in length, at a speed of 25 km an hour. The expense of operation, including the interest on capital invested and amortisation charge for a period of ten years, amounts to 12 centimes per car-kilometer, or 1 centime per passenger-kilometer. The pure operating expenses are 8 centimes and 0.66 centimes, respectively. In spite of the heavy grades, the coal consumption is only 1.9 kg per kilometer. The speaker also stated that the company was building some 100-hp cars of this type to draw two cars on an important branch of its line.

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THURSDAY'S SESSION

The chairman of the fourth session was Mr. Leon Janssen, manager of the Brussels Tramways and president of the Union Internationale de Tramways et de Chemins de fer d'interet local. The first question discussed was tramway legislation in different parts of Europe, and the paper on this subject was read by title, owing to the absence of the author, Mr. Scotter, of London. Mr. Gorella, secretary of the Street Railway Accident Guild, of Berlin, then presented the paper, "Accident Insurance of Street Railway Employees in Europe," which was published in the STREET RAILWAY JOURNAL for Oct. 1.

Mr. Björkegreen, of Berlin, then presented a report on the effect of electric tramways on measuring instruments in physical and electro-technical institutes, in which he described certain electrical measuring instruments which had been manufactured by Siemens & Halske, of Berlin. This apparatus is of all kinds, those employing the earth's magnetic field and those which are completely independent of the earth's magnetism. The instruments in the first class were in former times extensively used in scientific laboratories, but they have given place largely to instruments of the second class to avoid the disturbances due to the electric circuits of the tramways in the neighborhood. All of these instruments in the second class are based on the Desprez-d'Arsonval principle, which renders the electrical observations completely independent of the earth magnetic field. After having described a number of these instruments which are used to-day in all laboratories near electric tramway systems, Mr. Björkegreen described more especially a protected galvanometer of the Bois-Rubens type, which had been constructed for use in certain scientific institutions in Berlin, near which accumulator cars have been replaced by the overhead wire. In one case only, that of the tramway line between Berlin and Charlottenburg, has the company been obliged to install a double trolley wire 500 m in length to avoid using the earth as a return. If the overhead wire is destined to replace accumulator work, not only in Berlin, but in other cities of the Continent, it is on account of the construction of this modern apparatus.

Mr. Scholtes, of Nuremberg-Fürth, then presented his paper on the advantages and disadvantages of different kinds of brakes, which was published on page 333 of the Street Railway Journal of Sept. 3. In his conclusions, this speaker stated that in the resolutions passed by the association at its meetings in Geneva and London, it was said that "it is desirable to equip electric cars with two brakes, of which one ought to be a hand brake and the other may be an electric brake; and, furthermore, that the electric brake is preferable, as a rule, on account of its simplicity and security, and that it should be recommended as a service brake." These conclusions were confirmed by his recent investigations. Of the fifty-four roads from whom he had heard, 63 per cent were employing hand brakes, 22 per cent the electric brake, and 10 per cent to 15 per cent the air brake. The results which have been acquired from the experience of more than ten years permit the establishment of definite conclusions. Electric cars ought to be equipped with two independent brakes, of which one ought to be a hand brake and the other a mechanical brake. The speaker showed in his report to which mechanical brake he gave preference, and that it was the electric brake. Information in regard to the expenses of operation and maintenance of the different systems of brakes is unfortunately not very complete. It indicates, however, that the expense of maintaining air brakes is quite high and that they consume a considerable amount of current. The tramways of Munich are the only ones which do not consider that the air brakes consume a great deal of current. A communication from the municipal tramways of Vienna, in reply to his inquiry as to its brake practice, was one of the most interesting which he had received. It was in favor of electric brakes, although the company had had them in use for only a short time. The following factors are to be considered in the equipment of new cars:

1. The brake system should insure great security and should be able to be operated promptly. The car ought to be equipped with two complete independent systems of brakes; the service brake ought to be one which does not tire out the motorman.

2. Where the cars are heavy, or where trail cars are used, or where the street is congested, a hand brake is not sufficient as a service brake, and mechanical brakes should be employed, preferably an electric brake.

3. Where there are objections to the use of an electric brake as a service brake, such as where the motors are of small capacity, an air brake can be satisfactorily employed. Air brakes are also desirable when the cars are very heavy, when they operate at high speed or when the trains consist of more than two trail cars.

Mr. Marhold, of Berlin, did not agree with the previous speaker that the electric brake was superior to the air brake. He then described some tests on the relative consumption of energy by air brakes and by electric brakes which had been carried out in Berlin. The result of these trials, which were made with the greatest of care, was that the air brake took only 3 watts more than the Sperry brake. This additional consumption is so small that it is not worth considering in establishing any grounds of superiority. Mr. Marhold stated that in Berlin most of the motor cars are equipped with air brakes, although there are a few electric brakes. He noticed that the motorman always preferred to operate on cars equipped with air brakes, which indicated the superiority of this brake from the standpoint of simplicity. One of the principal advantages of the air brake is that it permits the establishment of responsibility in the case of accidents. When cars are equipped with an electric brake the conductor can always claim that the brake did not work, a thing which is very difficult to verify, but with an air brake the indication of the gage shows whether the fault is with the apparatus or with the motorman. This is a very important feature on a large road. The only trouble with the air brake, in the writer's opinion, is that the cost of maintenance is higher than with an electric brake. He is planning to compile some records on this subject. He criticised the second conclusion proposed by the original speaker, in which he said that "where the cars are heavy, or where trail cars are used, or where the street is congested, the hand brake is not sufficient as a service brake and mechanical brakes should be employed, and preferably the electric brake." The speaker believed that this was too strong an expression in favor of the electric brake. He preferred the use of the words electric brake or air brake. He then criticised the last paragraph (see above) where the statement was made that the air brake does not provide the same safety as the electric brake. He proposed that this conclusion should be changed so that it would read "the electric brake is desirable in most cases on account of its simplicity and its low price, and because it has many of the same advantages as the air brake."

Mr. Grialou, of Lyons, also disagreed with Mr. Scholtes. He thought that electric brake ought not to be employed as a service brake, but as an emergency brake only. In his opinion, the hand brake is perfectly satisfactory as a service brake. In requiring the use of the hand brake as a service brake, the manager is sure that it will be operated when it is required at the critical moment. Moreover, with a hand brake the motorman cannot as easily try to lay the blame for an accident upon the brake not working, an excuse which it is difficult to refute where the service brake is an electric brake.

Mr. Soberski did not agree with Mr. Grialou in regard to the use of a hand brake as a service brake. According to his opinion, it was not feasible where there were any grades or a large number of stops. The hand brake tires out the motorman; besides, tramway companies of to-day are increasing the weight of their cars, so that the hand brake will still further tend to go out of use.

After several other remarks by Messrs. Köhler, of Berlin; Theleman, of Düsseldorf; Gérard, of Brussels, and Thonet, of Liége, the association decided, in view of the differences of opinion, that the subject should be discussed at the next meeting.

As the last order of the day, Mr. Pedriali, of Brussels, presented a report on "Tests on Insulation Resistance and the Maintenance of the Trolley Wire." This was published on page 400 of the Street Railway Journal for Sept. 17. The speaker described various tests employed by him for determining the insulation resistance of the overhead and underground conduit system in Brussels. In conclusion, he made the following recommendations:

(1) Tests should be made at frequent regular intervals, and

the results should be entered in a record book kept for that purpose.

(2) The tension of the trolley wire at a temperature of 0 degs. C. (32 degs. Fahr.) ought to be between 450 and 500 kg (990 to 1100 lbs.) for wires 52.5 square millimeter in cross section (No. 0 B. & S.)

(3) The ears should be long and pliable and at least 380 mm (15 ins.) in length.

(4) The overhead frogs and switches should have long and pliable arms, which should be provided with guard shields so that the trolley pole will not tear down the overhead structure if it leaves the wire.

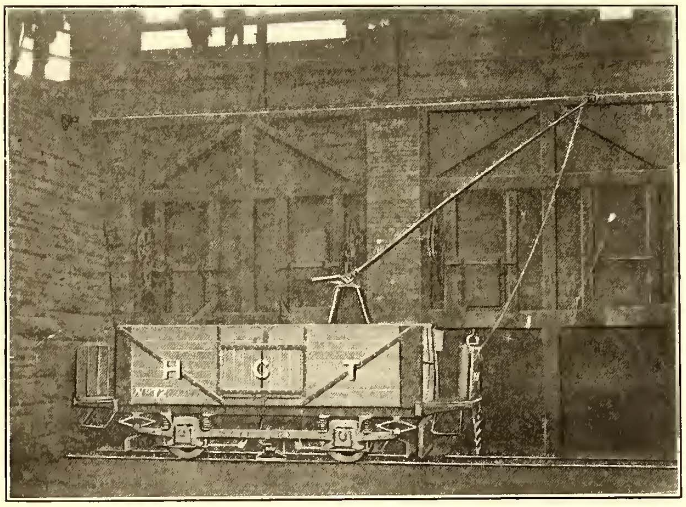
(5) Ordinary hangers should be provided with similar guards where the span is more than 45 meters (137 ft.).

(6) Where soldered ears are used, comparatively soft solder should be employed, and the trolley wire should not be allowed to get to too high a temperature.

The convention then adjourned.

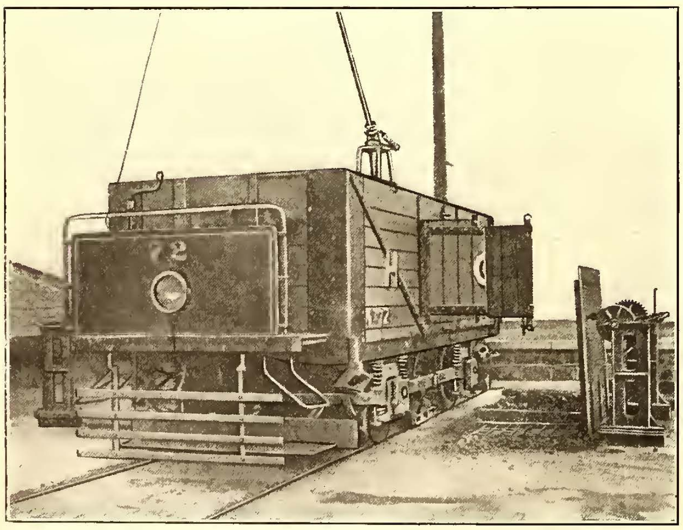
## COAL CAR AT HUDDERSFIELD

A coal car of somewhat novel design has recently been put in operation on the Huddersfield Tramway, and is said to be the first electric car of this kind in use in England. The car is




10-TON ELECTRIC COAL CAR USED IN HUDDERSFIELD

used not only to haul the coal for the tramway power house, but also for several large mills in Huddersfield, a distance of about 4 miles from the coal sidings. One especial novel feature of the




SIDE-DOOR DISCHARGE OF HUDDERSFIELD COAL CAR

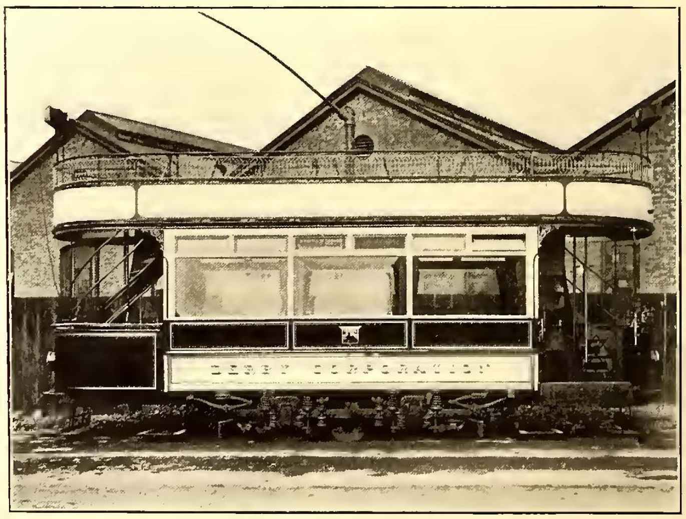
car is that as the coal chutes of the steam railroad company were located in rather an awkward position, and as they terminated only 7 ft. above the track, a special truck and car had to be designed to fit this corner. The car has a capacity of 10 tons, and its load is discharged from side doors, as shown in the engravings. The trolley pole is supported from one of the sides of the car. The car is mounted on a Brush radial truck and is equipped with two 45-hp Westinghouse motors, also the Westinghouse Newell magnetic brake. The truck and car body were supplied by Milnes, Voss & Company.

## RECENT ELECTRIC ROAD IN DERBY, ENGLAND

A good example of present city railway construction in Great Britain is shown by the recent installation in the city of Derby, which has a population of 125,000. The road has a length,


BRACKET-ARM CONSTRUCTION AT OSMASTON ROAD

measured as single track, of about 11 miles, and a gage of 4 ft. The track construction consists of a layer, 1½ ins. thick, of Portland cement concrete, composed of four parts of broken

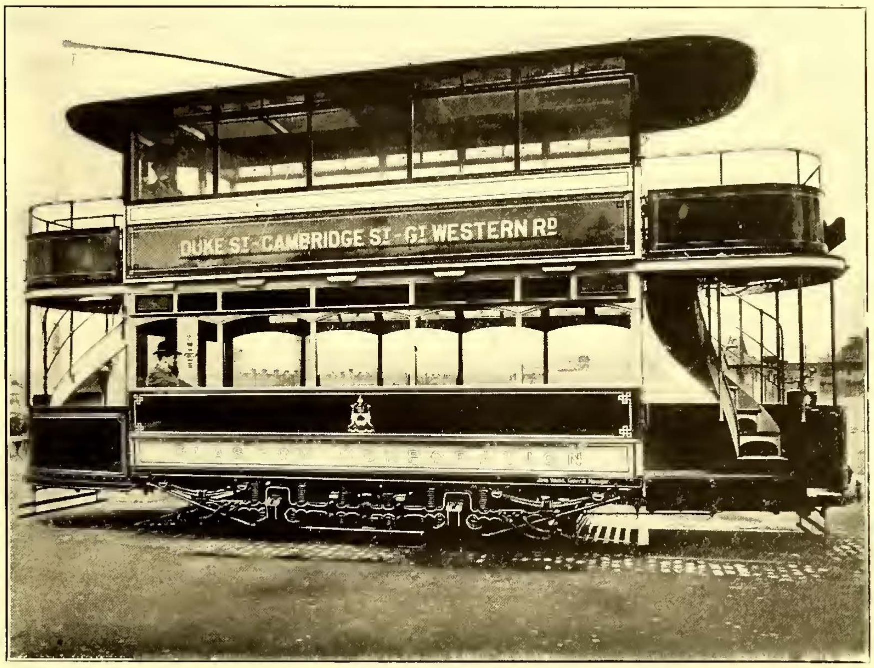



THE STANDARD DERBY DOUBLE-DECK CAR

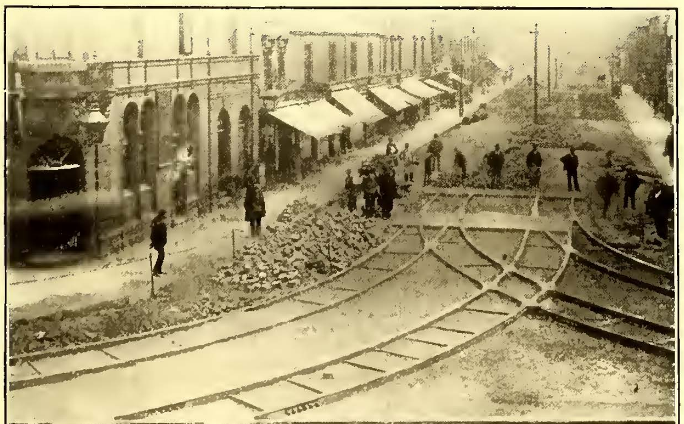
stone, two parts of sharp sand and one part Portland cement. Upon this was laid cement concrete 2 ins. thick, composed of three parts of ½-in. granite chips, one part clean sand and one part Portland cement. This was hand floated up to an even surface, with a longitudinal chase 10 ins. wide and 1½ ins. deep for the reception of the flanges of the rails. When the rails had been surfaced and the line fished and tied to exact gage, bonds and cross bonds inserted, the rails were covered with a coating of tar, and the chase containing the flanges of the rails was then flushed up solid to the same height as the upper layer of fine concrete, with a strong grout consisting of two parts of sharp sand and one part of Portland cement, finally flushed off with a trowel to the exact level. Afterward, both sides of the webs of the rails were filled up solid to the outsides of the running treads and the guard rails by good stiff mortar composed of two parts of clean sand to one part of Portland cement. The rails weigh 95 lbs. to the yard, with 101-lb. curve rails, and were supplied in 45-ft. lengths. Continuous rail joints are used. Five tie bars are employed to each 45 ft. of straight track, and about ten to each 45 ft. of curved rail; the main bar is 2 ins. wide x ⅜ in. thick. The bonds were of the Neptune type, and the track is cross-bonded every 30 yards. The points and crossings were supplied by Askham Brothers & Wilson and by the Hadfields Steel Foundry Company, Limited. The crossings are furnished with manganese inserts. Both center and side bracket poles are used.

The twenty-five cars at present in the sheds were supplied by the Brush Electrical Engineering Company, and are of the double-deck single-truck type. The over-all length is 28 ft.; width, 6 ft. 3 ins., and 6-ft. 9-in. high inside. The British Thomson-Houston Company, Limited, Rugby, supplied the electrical equipment, the motors being the GE 52, with type K-10 controller. The brakes are of the wheel, slipper and electric emergency types. The line was installed by J. G. White & Company, Limited.


CENTER-POLE CONSTRUCTION ON LONDON ROAD, DERBY




NEW DOUBLE-DECK CAR FOR GLASGOW



JUNCTION OF MIDLAND ROAD AND LONDON ROAD

## COVERED DOUBLE-DECK CAR IN GLASGOW

The Glasgow Tramways has recently put in operation a novel type of double-deck car which has practically been adopted as its standard for rolling stock, although a few changes may be made in details. The general sentiment in England is strongly in favor of double-deck cars, and double-deckers, although without a covered upper deck, have been used almost exclusively in Glasgow, practically ever since electricity was adopted. It has been found in Glasgow that while the upper deck is popular in pleasant weather it is practically abandoned in wet or cold weather, and to secure a deck load in all seasons it is necessary that the top seats should be dry and protected. On the other hand, a covered double-deck car with satisfactory head room for passengers requires a height from the street of not less than 16 ft. 6 ins. under the bridges. This is not always available, but in most cases it is thought that the street can be lowered to give the necessary clearance.

After considerable experimenting with different designs of double-deck cars, Mr. Young, general manager of the Glasgow Tramways, decided that, taking everything into consideration, a permanent roof with fixed windows and ample ventilators was best adapted for the service in that city. Observations will continue to be made, however, after the first lot of cars is in regular use. The use of fixed windows was adopted principally to reduce the cost of maintenance to a minimum. Ventilation is secured by side ventilators on each side of the car, arranged so that they can be opened or closed by one operation. End ventilators are also used.

In the first experiments, attempts were made to retain the existing easy stairways. This meant, however, closing in the entire upper deck, and the effect was to give the car a stiff and top-heavy appearance. Besides, there is a general feeling in favor of retaining outside seats for a few passengers on the canopy over the platforms. To admit of this it is necessary to enter the closed upper deck from the center instead of at the side, as in the case of the existing stair. It was resolved, therefore, to adopt a half-spiral stair. Mr. Young, however, could not get such a stair to satisfy him upon the present regulation platform. It was therefore decided to lengthen the platform by a foot. Thus a first-rate stair is provided, which in no way obstructs the motorman's view and avoids any clashing of lower and upper deck passengers, and the controller and brake handles are so placed in front that the motorman occupies the most commanding position, and there is space for a glass shield over the dash in front should it be wanted at any time.

The car body is exactly the same as the present standard car, and is seated for twenty-four inside. The cover is the same length as the car body, and, as the canopy extends over the full length of the platform, outside accommodation is provided for five passengers at each end. The seating capacity of the covered portion—with the absence of the trolley standard and a rearrangement of the seats—is thirty-two, thus giving total seating accommodation for sixty-six passengers. The construction of the upper roof, which in the present standard cars will give a clear head room of 6 ft. 1 in., is in accordance with the best practice. The side pillars and roof ribs are of polished ash, and the lining of narrow polished pitch pine and cherry alternately. It will be observed that the step to the platform is made to fold up. From an artistic point of view, the lengthening of the platforms and correspondingly of the protecting sheet and railing around the canopy over the platforms, gives more appearance of weight to the body of the car and, in effect, reduces the proportions of the top cover—which have been actually reduced by the lighter side pillars required for the fixed windows—all tending to give the car a more graceful appearance.

The Glasgow corporation has decided to proceed at once to have 100 of the present standard cars altered and covered practically to this design in the car works at Coplawhill. The first batch of these will be running shortly, and a proportion of covered cars will very soon be placed on each route. The streets are at present being lowered under some fourteen bridges so as to give the necessary height for the covered cars.

## ENERGY REQUIRED IN WATT-HOURS WHEN BRAKING WITH AIR

BY FRANK B. RAE

In the equipment of electric cars for interurban service, the air-brake system of braking which is generally preferred to other types of power brakes should be considered quite as much a part of the complete car equipment as the motors. This should apply as well to the smaller cars used in city service, but for some reason, probably that of first cost, or maintenance, or both, in very few instances have single-truck city cars been equipped with power brakes of any kind.

Apart from the direct and important advantage of power in applying brakes for the avoidance of accidents, cars so equipped can make a better schedule; the acceleration and braking rate may be higher than when hand brakes are used, and current can be saved during longer periods of drifting. These and other considerations, including the element of greater safety, must eventually bring about the equipment of the smaller cars with air brakes. There is no question regarding the reliability of the air brake, and the management that hesitates to equip cars with them, fearing their failure, makes confession of its inability to maintain its equipments properly.

The cost of electric energy for the operation of air brakes in watt-hours per brake application, or per cubic foot of free air compressed, is an interesting question to the management using, or contemplating the use, of air brakes, and this determination for the ordinary installation is therefore attempted.

For the best results in the use of air brakes, the determination of the proper size of the brake cylinder is important. The air brake manufacturing companies, however, have, as a result of experiment and practice, adopted certain sizes to be used within specified ranges of car weight, as shown in the following table:

DIAMETERS OF AIR-BRAKE CYLINDER FOR VARIOUS WEIGHTS OF CARS

| Weight of Car. | Diameter of Cylinder. |
|---|---|
| 50,000 to 70,000 lbs. | 10 ins. |
| 30,000 to 50,000 lbs. | 8 ins. |
| 20,000 to 30,000 lbs. | 7 ins. |
| 15,000 to 20,000 lbs. | 6 ins. |
| 10,000 to 15,000 lbs. | 5 ins. |
| 5,000 to 10,000 lbs. | 4 ins. |

The weight of cars is assumed without the load, the load being found a convenient margin between the car weight and the total weight, to produce the proper braking effect without skidding the wheels.

These general dimensions of brake cylinders as adopted, however, require that the air pressure shall be adjusted to them, considering also the weight of car and ratio of gear in this adjustment, in order to produce the proper braking pressure on the brake-shoes; and this is not always as carefully done as it should be. Where equipments consist of cars of uniform weight, the specifications for cylinder dimensions, brake gear, etc., should be made to fit a specified air pressure and the brake equipments then maintained to a constant effectiveness with this pressure, instead of, as is frequently the case, the air pressure being constantly increased to cover the inefficient maintenance of the apparatus. It will be found that correct brake cylinder dimensions, ratio of brake gear and proper adjustment provide for economy of operation as well as effectiveness.

### BRAKING EFFORT

It is important that the pressure upon the brake shoes or brake friction, plus the friction upon the axle bearings, or what is called the car friction, due to the weight of the car body and motors, must be a little less than the weight of the car, in order to bring it to rest without skidding the wheels. The car friction has been determined as equal to from 10 lbs. to 15 lbs. per ton, and for ordinary electric car service may be taken at 13 lbs. per ton. The braking effort of this friction therefore reduces by this amount per ton the total retarding effort necessary to bring the car to rest, and thus decreases by whatever relation it bears to the total retarding effort the amount of pressure to be applied to the brake-shoes.

The retarding effort required to bring a car to rest at any rate is the same as required to accelerate the same car at the same rate, or, in other words, the force required to accelerate a given mass through a given space in a given time, is the same force that must be applied to arrest this motion of the mass in the same space and time. From a knowledge of the effort required for accelerating a car of given weight, then, its braking effort required may be calculated as follows:

The acceleration of gravity for the average altitude of this section of the country is 32.16, so that the mass is equal to $\frac{\text{weight}}{32.16}$; if the weight is taken at 1 ton, the mass $= \frac{2,000}{32.16} =$ 62.2. If this mass is accelerated at the rate of 1 mile per hour per second, or $\frac{5280}{60 \times 60} = 1.466$ ft. per second per second, the force to produce this acceleration will be 62.2 x 1.466 = 91.21 lbs. The force necessary to arrest 1 ton at the rate of 1 mile per hour per second is therefore 91.21 lbs., or in other words, the force to be constantly applied, or the retarding effort, in braking is 91.21 lbs. per ton of car for a uniform retarding or braking rate of 1 mile per hour per second.

It is, of course, desirable that the rate of braking be as high as possible, and this is effected when the braking pressure on the wheels, plus car friction, is just below the skidding point. In practice this braking rate is usually taken at 2 miles per hour per second for a maximum, as a higher braking rate would subject passengers to disagreeable shocks. Therefore, to stop the car at this rate, the above retarding effort per ton will be doubled, or 91.21 x 2 = 182.42 lbs. per ton. The car friction, however, which has been taken at 15 lbs. per ton, reduces the effort that must be applied by the brakes to 182.32 — 15 = 167.42 lbs. per ton. It is also seen that $\frac{15 \times 100}{182.42} = 8$ per cent of the total retarding effort required, and that this 8 per cent, which is applied directly by the weight of the car, leaves 92 per cent of the weight of the car to be applied by the pressure of the brake shoes.

### BRAKE GEAR RATIO

To make this retarding effort available for braking the car, it must be transmitted to the brake shoes so that the friction in pounds pressure against the wheels is equal to 92 per cent of the weight of the car. This calls for a system of multiplying levers, or gear, between the cylinder piston and the brake shoe, and the ratio of this gear is determined by dividing 92 per cent of the weight of the car in pounds by the retarding effort in pounds, or

$$\frac{.92 \times \text{weight of car in lbs.}}{167.42 \times \text{weight of car in tons}} = \text{ratio of gear.}$$

The area of the brake cylinder then should be such that with a given air pressure in pounds per square inch, the necessary retarding effort is obtained by the pressure on the brake cylinder piston. This area is found by the following formula:

$$\frac{167.42 \times \text{weight of car in tons}}{\text{Air pressure in lbs. per sq. in.}} = \text{area of cylinder;}$$

from the area thus obtained, the diameter of the cylinder is at once known.

### EXAMPLE

The foregoing may perhaps be more clear if illustrated by an example in which we may assume the weight of car as 30 tons or 60,000 lbs., the air pressure at 60 lbs. per sq. in. and a braking rate of 2 m. p. h. per second. Then the area of the brake cylinder is $\frac{167.42 \times 30}{60} = 83.71$ sq. in., which is equal to a diameter of 10.3125 ins. The ratio of brake gear required is $= \frac{.92 \times 60{,}000}{167.42 \times 30} = 11$ to 1.

The pressure exerted by the brake cylinder is therefore 83.71 x 11 x 60 lbs. = 55,200 lbs., or 92 per cent of the car weight, and the equivalent pressure of car friction, which is 8 per cent of the weight of the car, is 60,000 x .08 = 4800 lbs., the two making a total of 60,000, which agrees with the weight of the car.

In practice, the pressure to be applied to the brake shoes in pounds is taken at 90 per cent of the empty car; this allows for a variation in car friction up to 16.5 lbs. per ton. The passenger load which is added in service, sufficiently increases the weight on the wheels so that the total retarding effort in pounds upon brake shoes and by friction is sufficiently less than the total weight on the wheels, as to prevent skidding.

### AIR PER BRAKE APPLICATION

The adjustment of the brake shoe at the wheel and slack in the brake gear will vary with wear, but should be maintained to average .5 in. to .6 in., which amount may also include the spring in rods, lost motion in joints, etc. The travel of the piston in the brake cylinder is therefore .6 in. x 11 (the lever ratio), or say 6 ins.; this space through which the piston has traveled = 83.34 sq. ins x 6 ins. = 500 cu. ins., is filled with air at 60 lbs. pressure for each brake application. Sixty pounds is equal to 5 atmospheres, therefore the free air used in the brake cylinder for each application of the brake is $\frac{500 \times 5}{1728} = 1.45$ cu. ft.

In addition to the air taken by the brake cylinder, there is a certain additional amount wasted from the train pipe which must be considered. For the average car, the piping between the engineer's valve and the brake cylinder is equivalent to about 45 ft. of ½-in. pipe, which has a cross-sectional area of .1963 sq. in.; this section therefore contains 45 x 12 x .1963 = 106 cu. ins., and the piping then takes $= \frac{106 \times 5}{1728} =$ say .30 cu. ft. of free air for each brake application. Adding this to the cylinder air required per application, makes the total amount of free air per brake application = 1.74 cu. ft.

As previously stated, the manufacturing companies elect to use brake cylinders of standard diameters, as noted in the above table of cylinder diameters, and adapt them to cars of various weights within the limits of practical variation of air pressure; hence for the weight of car selected in the example, a cylinder diameter of 10 ins. (area = 78.54 sq. ins.) would be used. The air pressure necessary in a cylinder of this size would be $= \frac{167.42 \times 30}{78.54} = 64$ lbs. Checking this calculation: 78.54 x 64 lbs. x 11 = 55,200 lbs. on the brake shoes, or 92 per cent of the car, as above stated.

### COST PER BRAKE APPLICATION

To determine the cost in watt-hours per brake application, it is only necessary to obtain the energy expended in compressing 1.74 cu. ft. of free air to 64 lbs. gage pressure. For single-stage air compressors, such as those used on cars, the mean effective pressure, including friction, has been given as, and may be assumed at 35.1 lbs. The foot-pounds for compressing 1.74 cu. ft. of free air to 64 lbs. pressure are therefore 35.1 x 1.74 x 144 = 8800-ft.-lbs; dividing this by the foot-pounds per minute in 1 hp. $= \frac{8800}{33{,}000} = .266$ hp. This is equal to .266 x 746 = 189.4 watt-minutes, or $\frac{198.4}{60} = 3.31$ watt-hours, which is the energy delivered by the brake cylinder.

The efficiency of compression, using a single-stage, geared, motor-driven compressor on the car, may be approximately taken at 42 per cent. The energy delivered to the motor is therefore $= \frac{3.31}{.42} = 7.9$ watt-hours. Taking the average transmission efficiency, including that of a motor starter, at 91 per cent, then the energy furnished at the station switchboard for each brake application is $= \frac{7.9}{.91} = 8.7$ watt-hours; and the energy required to thus compress 1 cu. ft. of free air to 64 lbs. gage pressure is $\frac{8.7}{1.74}$, or 5 watt-hours.

The following tables show the amounts of air required, energy in foot-pounds, and corresponding watt-hours required at car and station, per brake application, for the standard cylinder diameters, from which the cost of braking on any size of car may be found. It is, of course, apparent that for the efficiencies taken, the cost of watt-hours at the station per cubic foot of free air compressed to 60 lbs., will be the same for all cylinder diameters and for any stroke; and also that the cost per brake-application varies with the volume of air compressed for use in the several sizes of brake cylinders:

FREE AIR, COMPRESSED TO 60 LBS., CONSUMED IN BRAKING WITH CYLINDERS OF DIFFERENT DIAMETERS, THE STROKE IN EACH CASE BEING 6 INCHES

| Cylinder Diameter. Inches | Area. Square Inches | Volume in Cu. Ft. | Free Air, Compressed to 60 lbs., Used in Cylinders. Cu. Ft. | Free Air to 60-lb. Cylinder and Train Pipe Cu. Ft. |
|---|---|---|---|---|
| 10 | 78.54 | .272 | 1.36 | 1.74 |
| 8 | 50.26 | .174 | .87 | 1.25 |
| 7 | 38.48 | .134 | .57 | 1.05 |
| 6 | 28.27 | .099 | .49 | .87 |
| 5 | 19.63 | .068 | .34 | .72 |
| 4 | 12.56 | .044 | .22 | .60 |

ENERGY CONSUMED IN BRAKING WITH AIR AT 60 LBS. FOR CYLINDERS OF DIFFERENT DIAMETERS, THE STROKE IN EACH CASE BEING 6 INCHES

| Diameter Cylinder. Inches. | Free Air, Compressed to 60 lbs. Cu Ft. | Foot Lbs. M. E. P. = 35.1 | Watt-hours at Car | Watt-hours at Station Eff. = 38% |
|---|---|---|---|---|
| 10 | 1.74 | 8800 | 3.31 | 8.70 |
| 8 | 1.25 | 6360 | 2.38 | 6.25 |
| 7 | 1.05 | 5340 | 2.00 | 5.25 |
| 6 | .87 | 4400 | 1.65 | 4.35 |
| 5 | .72 | 3640 | 1.36 | 3.58 |
| 4 | .60 | 3320 | 1.25 | 3.28 |

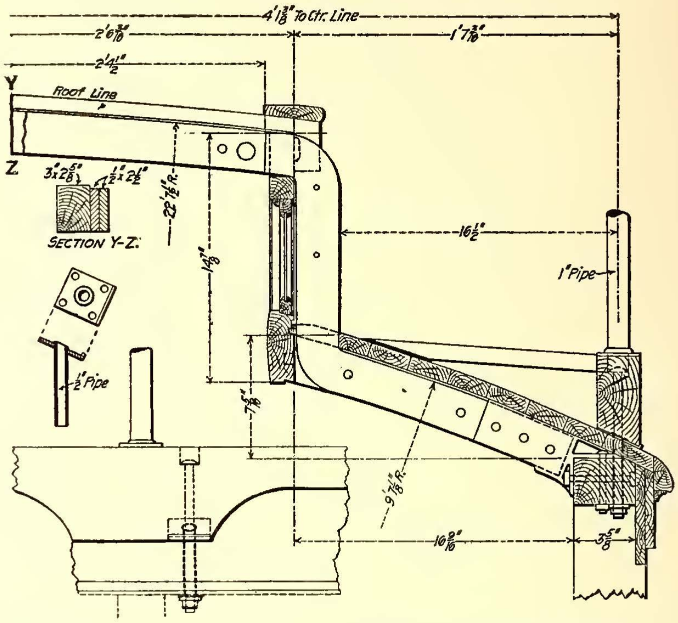
## A NEW TYPE OF AMERICAN DOUBLE-DECK CAR

An interesting attempt toward the adaptation of the double-deck car principle to American street railway operating conditions has recently been made at Minneapoli , Minn., in the introduction of a novel type of convertible double-deck car. The need of better facilities for handling the heavy summer traffic of the operating company, the Twin City Rapid Transit Company, between Minneapolis, St. Paul and the two important summer resorts reached by their lines, has for some time been felt, and the new design of car described below was suggested as perhaps more convenient and flexible in operation than the trail cars originally in use.

The principal details of the new car are shown in the accompanying view and drawings. Perhaps the most novel feature is the construction of the roof of the lower, or closed, part of the car. One of the principal requirements of the design was that the lower part of the car should correspond, both in appearance and utility, with the standard car in use, and that the upper, or open, structure might be removed, leaving the lower car complete for operating as a single-deck car. The reason for this is that these cars will be used for the excursion business during the summer months, while, on account of the severe weather in Minnesota in winter months, the upper seats could not be utilized in any case.

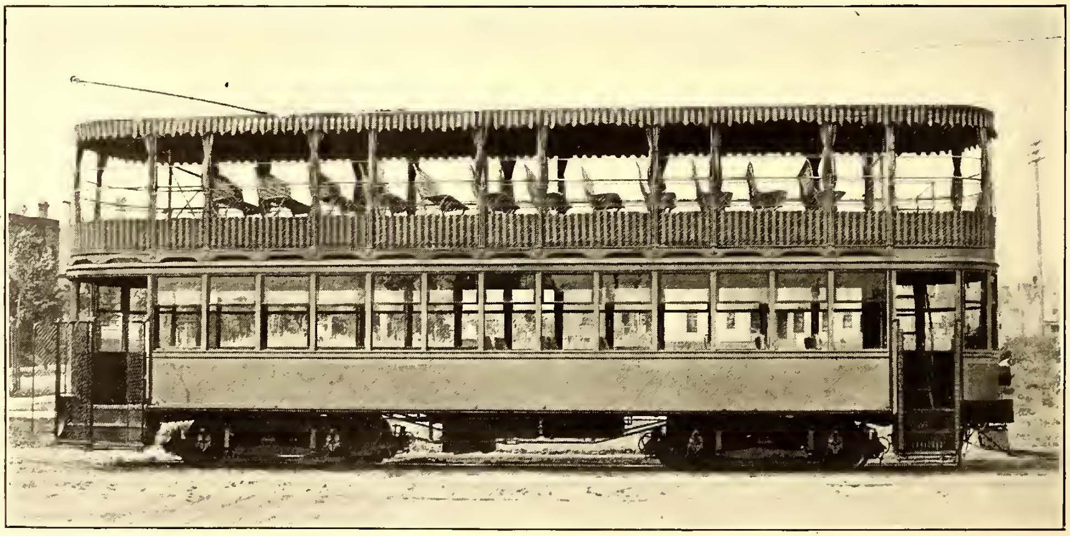
It is interesting to note that it is found that this car will seat forty-eight people on the upper deck, in addition to the capacity below of fifty-one seated and sixty-five standing. This is a remarkable achievement for a 45-ft. car. The entire weight of the car and equipment proves to be only about 26 tons.

The construction of the lower portion of the car is identical with that of this company's standard car, which was fully described and illustrated in the March 1, 1902, issue of the STREET RAILWAY JOURNAL. As an exception, however, the trusses and cross sills are built heavier, and the roof is heavily reinforced with iron carlines, ½ in. x 2½ ins. in section, placed over each




PART SECTION OF ROOF TO SHOW METAL CARLINE CONSTRUCTION AND SPECIAL ATTACHMENTS OF UPPER-DECK SIDE-PLATES TO ROOF

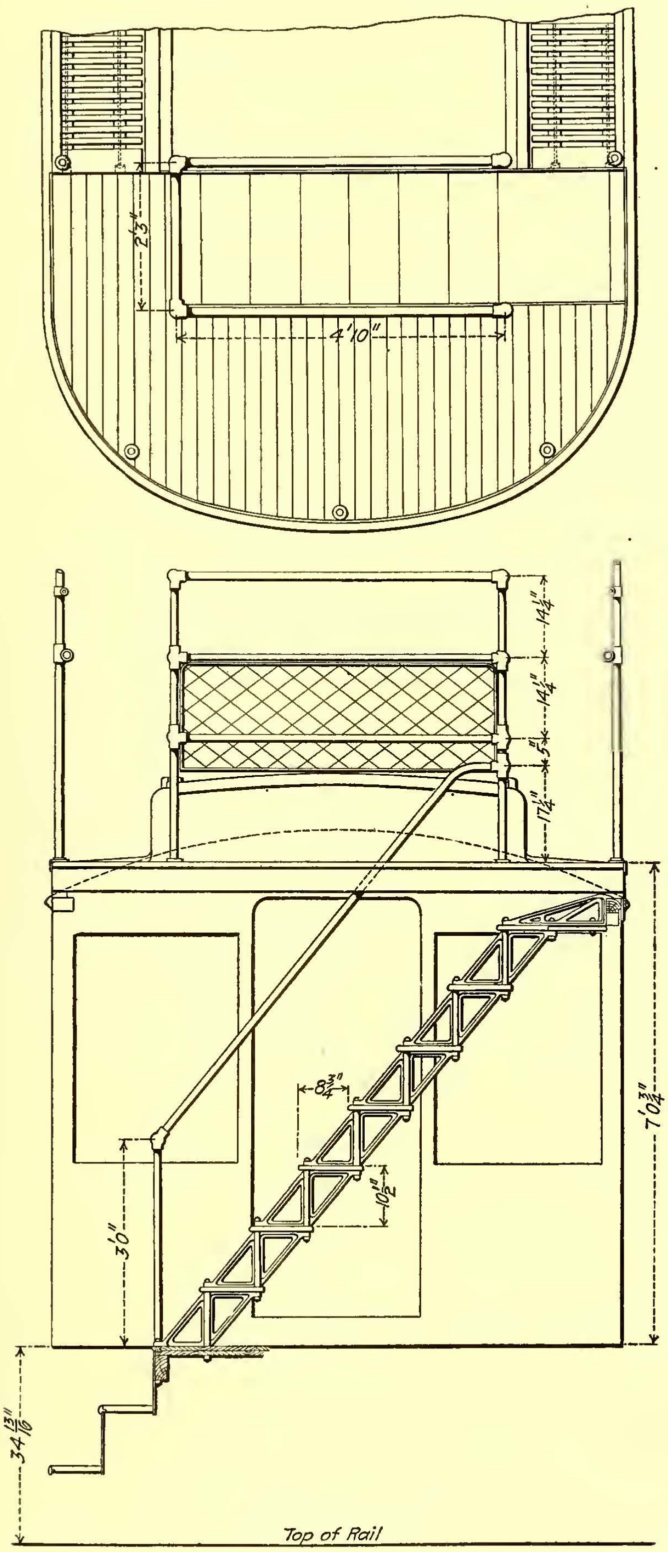
side post, and provided at the ends with a cast shoe, bolted to the side plate, to provide the firmest bearing. The roof boarding is, of course, much heavier to withstand the walking thereupon, and the runways at the sides of the deck are provided with open-rack walkways to protect the roof covering. The bow roof over the front vestibule, and also the overhang of the deck roof, is so made as to be removable when the upper deck is used for passengers; the front vestibule is then covered by the



APPEARANCE OF THE NEW TYPE OF CONVERTIBLE DOUBLE-DECK CAR FOR TWIN CITY RAPID TRANSIT COMPANY

special platform, shown above the cross section, in the drawing, having a hatch with a stairway, and so arranged as to provide a passage from the stairs to either runway. This affords easy access to both ends of the seats used upon the upper deck, which are placed crossways on the deck roof. The stairway runs transversely, as shown in the front elevation, at the rear of the front vestibule, and is accessible only to passengers entering at the front of the car. Both front and rear entrances to the car are made by two-tread steps, and are provided with standard double safety gates, used by the Twin City Company.

The height permissible for the upper deck construction was limited by the overhead line construction, and entrances to car houses and viaducts. On account of the height required by a double-deck car in any case, it was, of course, furthermore, desirable to make the appearance of the upper work as light as




PART END ELEVATION AND UPPER-DECK PLAN OF THE MINNEAPOLIS DOUBLE-DECK CAR, SHOWING DETAILS OF STAIRWAY UPON FRONT PLATFORM

possible. The upper structure consists of a frame work of 1-in. gas pipe bolted to a 2½-in. x 5-in. sill, which rests on special fittings built permanently into the roof, providing an opening down through the plate of the car framing, as shown in roof section drawing. The sill is held by bolts passing down through this casting and bolted below.

The canopy frame work is arched 2 ins., and at the ridge running from front to rear are two 6-in. planks, the lower one cutting in between the piping of the frame and the upper continuous. Toward the rear, a short plank, about 10 ft. long, is added on each side for supporting the trolley base. On the under side of this ridge plank is mounted the signal bell and lighting equipment.

The top has a covering of awning material, and above this is one thickness of painted ducking. A strip of awning material 18 ins. wide is placed just above the sills, as shown in the illustration, and the remaining space may be closed by sliding curtains, which are normally strapped to the posts. The pole, or left hand, side is entirely closed by wire screens, while on the right side the space is thus screened to a height of 3 ft. At this point is a heavy hand rail, and about one foot higher there is a light guard rail.

As above stated, the seats upon the upper deck are arranged crosswise upon the deck elevation. Each cross seat will accommodate four persons comfortably. Their construction is indicated in the view, consisting of cast-iron end frames with slat filling, as shown, so as to withstand the effects of rain in case the curtains are not drawn. The seats are easily approached; the stairway to the upper deck having only eight steps of 10½-in. rise each, while the rise from the side walkways up on to the deck where the seats are located is a single step of about 15 ins.

The car was built by the company at its large repair shop in Minneapolis. It is mounted upon Brill trucks, and is equipped with four General Electric Company type 57 motors, geared to about 26 miles per hour. Acknowledgment is due to W. J. Hield, general manager of the Twin City Rapid Transit Company, for this information.

## THE EQUIPMENT OF THE EVANSVILLE SUBURBAN & NEWBURGH RAILWAY WITH ELECTRICITY

The Evansville Suburban & Newburgh Railway, with headquarters at Evansville, Ind., and which has been operated as a steam railroad for the last fifteen years, is being equipped with the overhead trolley for passenger service. Steam will, however, continue to be the motive power for the freight service.

In making this change of power, the company is availing itself of the opportunity given for betterments, and is rebuilding the entire line. New ties have been put in, the track has been relaid with 70-lb. rails, and the whole has been filled in with rock ballast. The pole line is being set with chestnut poles from Tennessee. The maximum grade on the line is seven-tenths of 1 per cent. There is one curve with a 95-ft. radius, but, exclusive of this, the greatest curve is of 8 degs. Power will be rented for the present, and will be converted at sub-stations along the line.

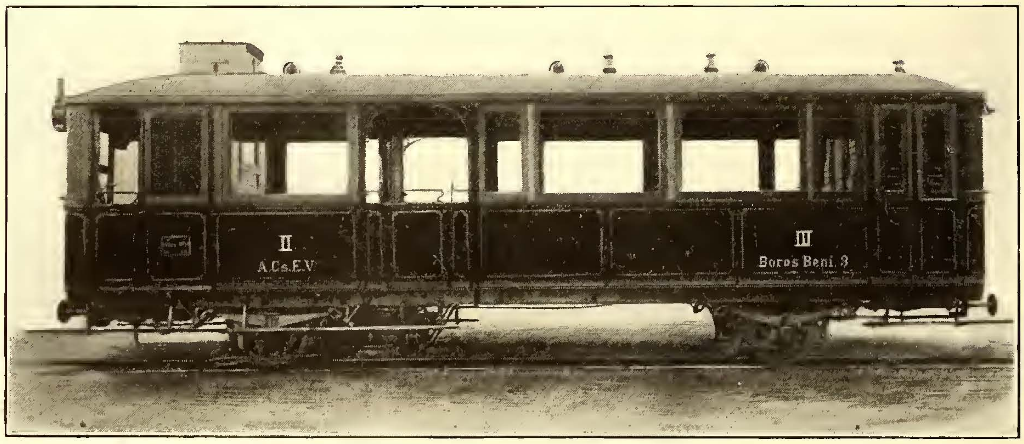
The rolling stock now consists of three engines, twelve coaches and thirty-two freight cars. The coaches will be used as trailers, and will be drawn by motor cars now in course of construction at the St. Louis Car Company's plant. These cars, three in number, will each be 46 ft. long x 9 ft. wide, and will be equipped with the St. Louis Company's No. 50 trucks, with hollow spoked wheels with Midvale steel tires. The interior finish of the cars will be in solid mahogany, with full empire top. French plate glass will be used in the windows, the upper sash to be elliptic in shape and filled with art glass. The seats will be finished in rattan. Hot-water heaters will be installed. There will be four 55-hp motors to each car, with type M control.

It is contemplated to extend the line next year to Boonville, a distance of about 10 miles. Additional cars will be added when this has been done. The company now does a regular freight and passenger business, handling freight in standard box cars.

## STEAM MOTOR CARS USED ON EUROPEAN INTERURBAN RAILWAYS

Although self-contained railway motor cars are as yet rare in the United States, they are used quite extensively in European countries, where much attention has been given to their practical development. Ganz & Company, of Buda-Pest, have been particularly interested in this work, and a number of cars built by them are now in use on light railways in Austria and Hungary. Several of these cars are shown in the accompanying illustrations.

THREE-AXLE STEAM MOTOR CAR FURNISHED FOR THE ARADER & CSNADER UNITED RAILWAYS



TWO-AXLE STEAM MOTOR CAR FOR THE ARADER & CSNADER UNITED RAILWAYS

The standard Ganz steam motor car is fitted with a reversible, compound-cylinder steam motor of 35-hp capacity. The compound construction permits a higher economy in steam consumption, but when additional power is required, as on grades, the throwing of a switch suffices to convert the motor to a twin steam engine.

NARROW GAGE STEAM MOTOR CAR OF 35-HP CAPACITY USED ON THE ALFOLDER RAILWAY

The motor is installed in a dust-proof cast-iron casing, which also serves as a receptacle for the oil which continuously lubricates the motor. The first supply of oil is usually about 20 kg (44 lbs.), and the monthly renewals about 5 kg to 6 kg (10 lbs. to 12 lbs.). The motor cylinders are lubricated separately by a pressure pump. The motor is so well protected from tampering that it rarely requires more than a monthly inspection at the shops. The motor housing is placed on the driven axle, forming with it an organic whole, so that by loosening a part of the truck and piping the engine and shaft can be removed and replaced as easily as an ordinary axle. Similar parts of all motor equipments are interchangeable, thus facilitating repairs.

Power is transmitted to the driven axle by two pairs of gears. This arrangement has been found to give smooth running, as the wheels rotate more uniformly than if the usual locomotive driving axles were employed, besides avoiding the increased road wear caused by reciprocating motion. The use of gearing offers the further advantages of permitting better adjustment for changes in speeds and loads, and allowing the use of small high-speed engines of large capacity. The weight of the present standard motor is 750 kg (1500 lbs.), which causes no excessive pressure on the axle. The boiler takes up very little room, as it is only 820 mm (32.3 ins.) in diameter and 1100 mm (43.3 ins.) high. It is fired from above, and requires very little attention during a trip. Coke or charcoal is used for fuel on account of cleanliness. The boilers are also made with interchangeable parts and can be quickly removed for inspection.

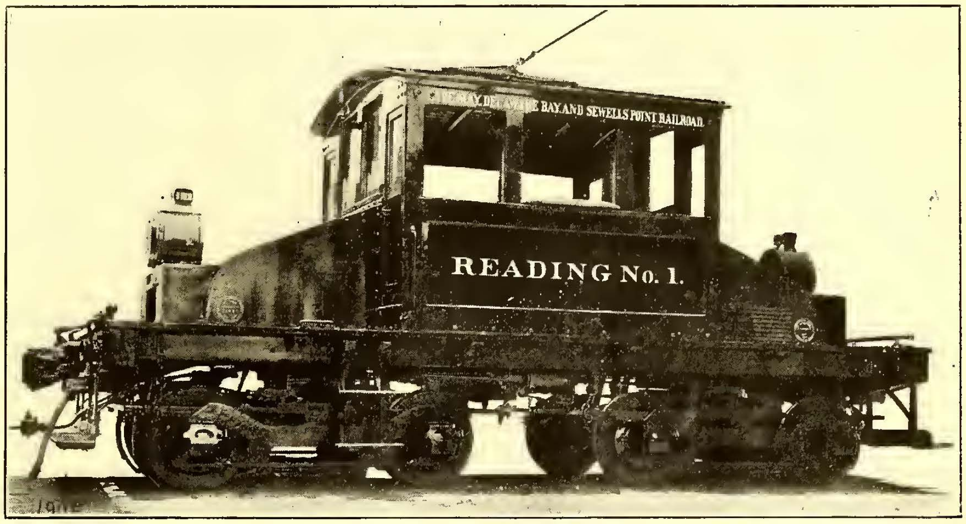
It has been found that with this system the average fuel consumption is 1.5 kg to 3 kg per kilometer (5 lbs. to 10 lbs. per mile) with single-motor cars, and 2.5 kg to 4 kg per kilometer (8.33 lbs. to 13.33 lbs. per mile) with double-motor cars. The single-motor cars carry about 12 liters (3.17 gals.) of water, and the double cars about 24 liters (6.34 gals.) for trips covering 60 kg to 70 kg (36 miles to 42 miles). The maximum speeds of the different types vary from 55 km to 85 km (33 miles to 51 miles) per hour.

The principal features of the motor cars are the use of either chilled-iron or steel-tired wheels, arranged in pairs; eight-shoe hand or power brakes, which can be operated from either end of the car, like the apparatus for regulating the motor; passenger divisions of the first, second and third classes, with furnishings to correspond; steam heating; oil, gas or acetylene lighting, etc. The motor car is capable of hauling a trailer carrying 100 to 150 passengers, including baggage; the operating cost of such a train is given as approximately one-fourth the cost of locomotives. The total weight of a motor and trail car without passengers is about 20 tons. The table accompanying this article is taken from figures furnished by the Würtemberg State Railways, and gives an interesting comparison between the system described and others in performance and fuel consumption, especially per seat-mile.

| | Daimler Benzine Motor | Serpollet Steam Motor | Accumulator | Ganz Steam Motor |
|---|---|---|---|---|
| Approximate weight of car, in tons. | 15.7 | 22.1 | 35.4 | 14.3 |
| Number of seats ..................... | 24 | 32 | 56 | 33 |
| Average cost of car.................. | $7,517 | $7,517 | ...... | $6,547 |
| Daily performance, in miles......... | 56.4 | 54 | 54 | 120 |
| Fuel cost per mile.................. | $.0352 | $.0302 | ...... | $.027 |
| Cost of lubricants, per mile......... | .0025 | .0023 | ...... | .001 |
| Total cost of supplies per mile..... | .0377 | .0325 | .1042 | .028 |
| Total cost of supplies per seat-mile. | .00157 | .0098 | .01768 | .0082 |

## AN ELECTRIC FREIGHT LOCOMOTIVE FOR THE PHILADELPHIA & READING RAILROAD

The Philadelphia & Reading Railroad is preparing for the handling of freight traffic upon an extensive scale by an electric locomotive upon its Cape May, Delaware Bay & Sewell's Point Railroad branch. This branch is a 7-mile electrically operated line, extending from Cape May Point to Sewell's Point, formerly operated mainly for passenger service; now freight also will be handled from both the Philadelphia & Reading and the Pennsylvania Railroad to this newly developed portion of Cape May.



ELECTRIC FREIGHT LOCOMOTIVE OPERATED BY THE PHILADELPHIA & READING RAILROAD

The electric locomotive which will be used is illustrated in the accompanying engraving. It involves many interesting features attendant upon the mixed character of service for which it has been designed. As may be noted, it is equipped with both the M. C. B. standard automatic type of coupler for freight service and the street car type of coupling for operating trolley car trailers, shifting purposes, etc. The locomotive is also equipped with bumper steps at both ends for switchmen, in accordance with steam railroad switch-engine practice. Shifting work will be facilitated by the new "straight-air" attachment, in addition to the regular automatic air equipment, which has recently been perfected by the Westinghouse Air Brake Company; this enables the numerous quick stops, so necessary in switching, to be made without exhausting the main reservoir supply.

The locomotive was built by the Baldwin Locomotive Works, Philadelphia, Pa., by whom the accompanying photograph was furnished. The motors, control system and other electrical equipment were supplied by the Westinghouse Electric & Manufacturing Company. The important details of the locomotive's equipment are presented in the accompanying table. The tractive effort possible with this locomotive is especially high, ranging considerably higher than that of a steam locomotive of equal weight, due to the fact of all wheels acting as drivers.

EQUIPMENT SPECIFICATIONS

Gage of track..........................................4 ft. 8½ ins.
Wheels ................................................Eight 30-in.
Driving wheel-base ..................................18 ft.
Truck wheel-base ......................................6 ft.
Distance between truck centers....................12 ft.
Length of frame over end sills.....................23 ft.
Width over all ...........................................9 ft.
Height from top of rail to center of draw-bar..........2 ft. 10½ ins.
Height from top of rail to top of platform..............3 ft. 8 ins.
Height from top of rail to top of cab......................11 ft.
Weight in working order...............................40,000 lbs.
Motors ..................................Four 50-hp Westinghouse type 38-B
Motor controller................Westinghouse type K-14, magnetic blow-out
Gear ratio ..................................................14 to 68
Full-load speed on level....................................10 miles per hour
Speed with lighter load...............................12 to 15 miles per hour
Full-load draw-bar pull on level.................................6000 lbs.
Starting draw-bar pull on level, with clean, dry rail..................8000 lbs.
Frames.....................................Steel channels, heavily braced
Driving wheels...................................Cast iron, spoke centers
Tires...........................................Cast steel, 3 ins. thick
Axles .................................................Forged steel
Journals..................................3¾ ins. diameter, 7 ins. long
Driving boxes.............................Cast iron, with bronzed bearings
Brakes.....Hand and Westinghouse automatic and straight air, on all wheels
Couplers and bumpers...................................M. C. B. standard
Sanders..............................Air operated, with spouts front and back
Air whistle and foot gong.
Electric heaters and lights in cab.

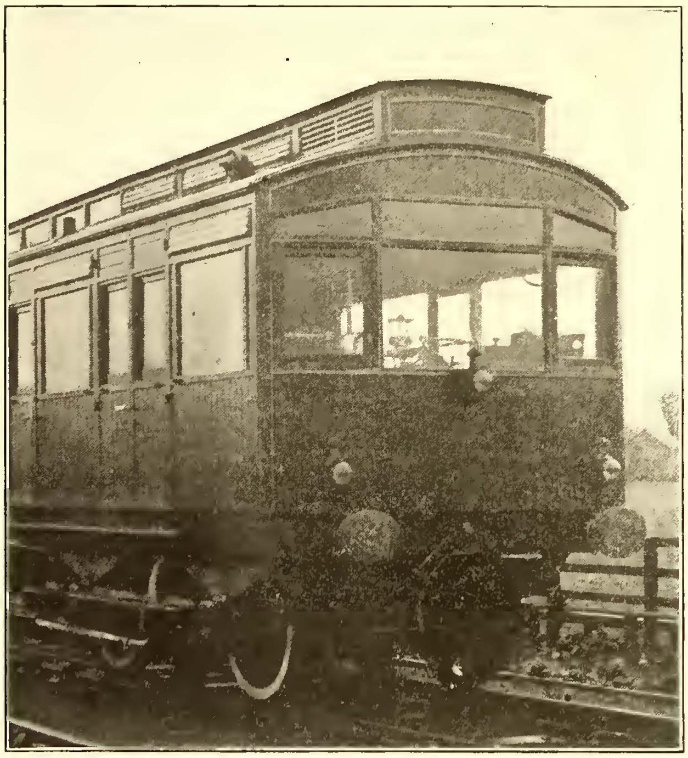
## SPEED POWER TESTS IN INDIANA

The plans of the Electric Railway Test Commission for carrying out a series of speed power tests, described in the Street Railway Journal for Oct. 22, are progressing very satisfactorily. The Indiana Union Traction Company has set aside a comfortable office in the Union Building, Anderson, for the superintendent of the tests, and has also provided a large, well lighted drafting room fitted with drawing tables and other conveniences for the use of the test corps. The railway company is also preparing to assist materially in the preparation of the apparatus, and the greatest interest is being taken in the work by the general manager of the company, the electrical engineer, the master mechanic and others connected with the company.

When the trolley line is completed between Chicago and Kenosha a short stretch of it will probably become a battle ground for the average male citizen who does not profess allegiance to John Alexander Dowie. The company which has obtained a franchise through Zion City is under agreement, it is stated, to employ none but Dowieites as conductors and motormen for the handling of the cars while passing through Zion City, and passengers will be required to refrain from the use of tobacco or liquor in any form and from profanity as well. The conditions on which the franchise was obtained provide that Dowie's followers must lay the track through Zion City, as well as operate the cars. The company also is to pay $3,000 an acre for all the land actually occupied and guarantee the enforcement of Dowie's rules under penalty of forfeiture of the franchise. Already the company is beginning training motormen and conductors.—Chicago "Chronicle."

## SELF-PROPELLED PETROL ELECTRIC RAILWAY CARS OPERATED BY THE NORTH-EASTERN RAILWAY COMPANY OF ENGLAND

The North-Eastern Railway Company, of England, has been using for some time on its line between Scarborough and Filey two petrol electric cars, each propelled by a 90-hp four-cylinder Wolseley petrol motor coupled to a Westinghouse generator.

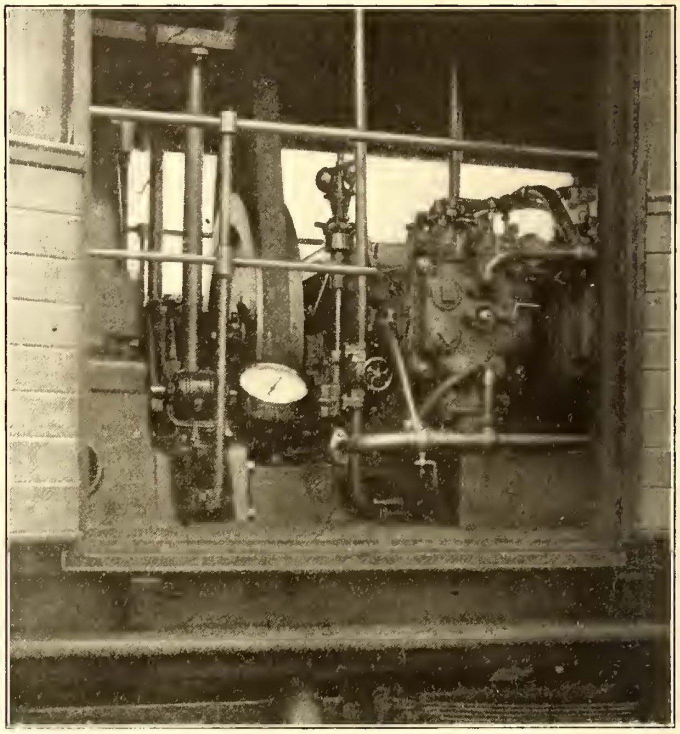


VIEW OF THE AUTO-CAR, SHOWING THE SIDE AND END ELEVATION

These cars were designed and equipped by the Wolseley Tool & Motor Car Company, Limited, of London and Birmingham, and are of a type designed to meet the need for an auxiliary railway service to act as a feeder to main lines, and to enable a self-contained car to carry passengers, baggage and mail in whatever proportion desired over routes in outlying thinly populated districts where the usual methods of operation would be uneconomical.

The usual length of the cars for standard gage service is 53 ft. 3 ins. over the buffers, and the width 9 ft. 6 ins. They are permanently fitted as enclosed vehicles, in accordance with customary English practice, but, if desired, car bodies of the tram car type could probably be utilized to advantage. The third-class car is intended to seat forty-eight passengers and the necessary attendants. The composite first and second-class cars are designed for fourteen first-class and twenty-four second-class passengers. Reversible cross-seats are provided for third-class traffic.

Each car is mounted on two four-wheel swivel motor trucks

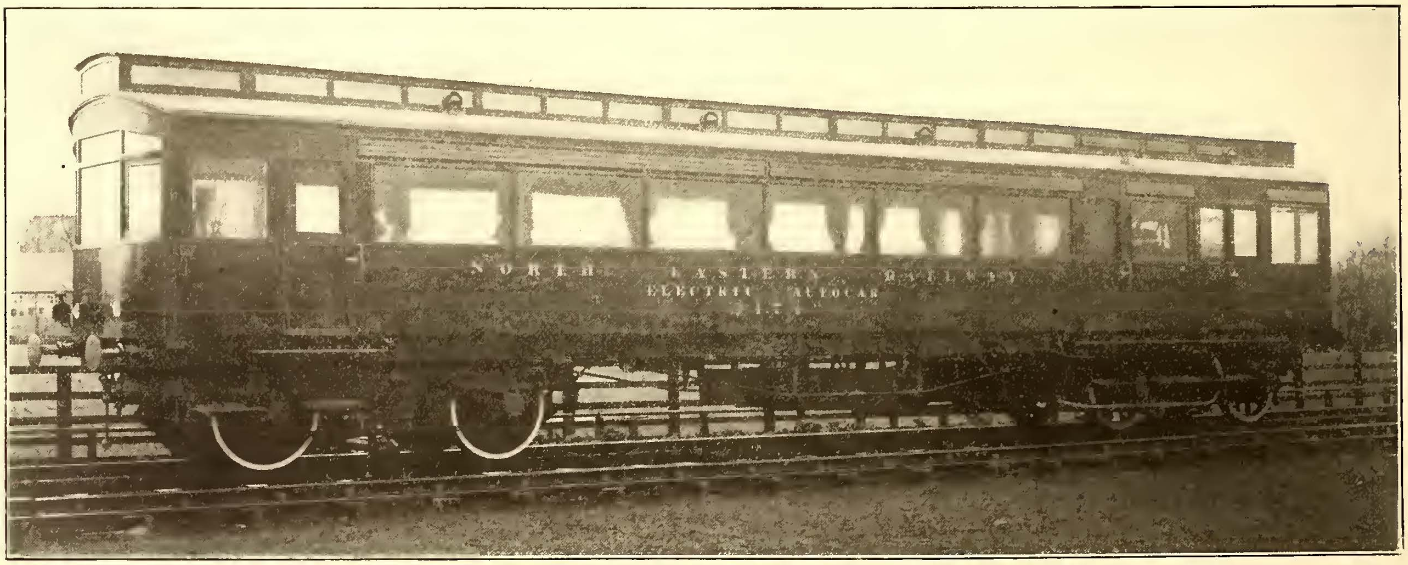


APPARATUS IN THE ENGINE ROOM OF THE AUTO-CAR ON THE NORTH-EASTERN RAILWAY

of the Leeds forge type, which have their centers 34 ft. apart. The truck wheels are 8-ft. centers and 3 ft. 6 ins. over treads.

The direct-coupled petrol-electric generating set is installed in an engine room at one end of the car. This compartment also contains a 5-kw exciting dynamo for exciting the generator fields, for charging a small accumulator battery for lighting, etc. The engine compartment also contains a complete set of controllers, regulating resistances, switches and other apparatus for operating the car. Another set is installed at the other end of the car.

The prime mover is a Wolseley 90-hp four-cylinder petrol



ONE OF THE ELECTRIC AUTO-CARS IN SERVICE ON THE NEWCASTLE DIVISION OF THE NORTH-EASTERN RAILWAY engine. The four cylinders are each 8½-in. bore x 10-in. stroke, giving 81 bhp at 420 r. p. m., and 93 hp with an acceleration up to 480 r. p. m. The cylinders work in pairs on two crank pins at 180 degs. from each other, thus obtaining two impulses per revolution. The electric generator is of 60-kw capacity at 500 volts and 450 r. p. m. The motors on the trucks are each of 50-hp capacity. A 90-amp. battery of forty accumulators is contained in a suitable box suspended beneath the center of the car. It is used for lighting and for starting the petrol engine through the exciter.

Either Westinghouse automatic air brakes or vacuum automatic brakes may be used, the air compressor in one case and the air pump in the other being driven by a small motor. Powerful screw-on compensated hand brakes are also provided, a brake wheel being fixed at each end of the car.

Petrol and water tanks are installed of sufficient capacity to enable a car to run continuously for five hours at speeds up to 30 miles an hour.

It is interesting to learn in this connection that the Wolseley Tool & Motor Company, Limited, reports that it has secured an

VIEW OF INTERIOR LOOKING TOWARD THE MOTORMAN'S COMPARTMENT

order from the General Electric Company, of Schenectady, N. Y., for a six-cylinder petrol engine to develop 140 bhp. This will be installed on a petrol electric railway car to be built by the latter company. In addition to the type described, the Wolseley Company also builds other styles of petrol cars to suit different operating conditions.

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The Springfield (Ohio), Troy & Piqua Railway Company has perfected arrangements with other roads in that vicinity whereby tickets are sold through to points on these roads. Under the arrangements with the Dayton & Troy Electric Railway and the Western Ohio Railway, it will sell tickets to Piqua, Sidney, Wapakoneta, Lima and other points north. Under arrangements with the Springfield & Xenia Traction Company and the Dayton & Xenia Traction Company, tickets will be sold to Xenia and Dayton.

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The employees of the Oakland Traction Consolidated are organizing a mutual improvement association, which will probably include all the trainmen on the system. The company has offered to provide club rooms for the association, and for that purpose is changing over a portion of the old power house on San Pablo Avenue, where the offices of the company are at present located. The rooms will include a first-class gymnasium, with baths, reading room and recreation room, and will be fitted up so as to provide every comfort for the men.

## MEETING OF NEW ENGLAND STREET RAILWAY CLUB

The October meeting of the New England Street Railway Club was held in Wesleyan Hall, Bromfield Street, Boston, on Thursday evening, Oct. 27, at 7:30 o'clock. Prior to the reading of papers, a business meeting was held. It was decided to postpone action on the date of the annual meeting until February, and the other proposed amendments to the by-laws and constitution, mentioned in the Street Railway Journal of Oct. 22, were indefinitely tabled. A number of candidates for membership were admitted to the club, after which President Neal introduced the speakers of the evening.

The subject was "Track Construction and Maintenance," the first paper being presented by Gilbert Hodges, consulting engineer, of Boston. Mr. Hodges' paper was a comprehensive review of the evolution of track from the early days of improved haulage of vehicles on roads to the present time. Referring to the early history of track work, he spoke of the parallel lines of flat stones laid long ago upon some of the Roman roads, and mentioned the timber track used in England in the latter part of the seventeenth century. In 1826 a road was built at Quincy, Mass., consisting of simple T-rails fastened to cast-iron chains attached to the ties, which were of stone. These rails were cut in 12-ft. lengths. Some of the other early rail sections in Massachusetts consisted of angle or U-shaped pieces of iron which were spiked to the timbers; these were superseded by a flat or tram rail 4 ins. or 5 ins. wide, and weighing 30 lbs. to 50 lbs. per yard. They were spiked to the timbers, and flat iron plates with elongated holes were placed underneath the joints. The elongation was for the purpose of providing for expansion and contraction. Spruce or hemlock ties were used, generally 4 ins. x 6 ins. cross section and 6 ft. 6 ins. long, spaced 4 ft. to 5 ft. apart. Sometimes the spacing reached a maximum of 12 ft.

Roads have been built with neither ties nor tie rods, but the best forms of early track were all equipped with iron tie rods. Girder rails came into use even before electric motive power. The early types were light and shallow, mounted on cast-iron chairs. One of the early forms of girder rail was the Longstreet, which was installed in Providence, R. I. It had a T-rail head; was 6 ins. or 7 ins. deep, and rested on steel chairs embedded in concrete. Its first cost was high, and the maintenance expense was considerable. Later on, P. F. Sullivan, now president of the Old Colony Street Railway Company, designed a 9-in. girder rail with a tram head and a wide bottom flange, and the first one of these was rolled by Wm. Wharton, of Philadelphia, and put down in Lowell, Mass. The Boston Elevated Railway Company has recently put down an 8-in. T-rail in one of the suburban towns covered by its system. The ties used are 8 ft. long, spaced 2 ft. on centers; they are tamped with gravel; then two layers of concrete are put in, followed by granite blocks grouted with small stones. The finished surface is filled in with bitumen, and tie rods are placed every 5 ft. or 6 ft.

Mr. Hodges gave it as his opinion that 60-ft. rails are suitable for use in deep T and girder forms in paved streets. Thirty-ft. T-rails are about the maximum desirable length where shallow rails are required. A 70-lb. T-rail with careful joint construction and 2-ft. spacing of ties, makes a good track for economy and durability. The deep girder rail is not very satisfactory, because the first cost is high, and a large part of the material of the section is subjected to no wear, but still must be sold for a scrap valuation. In large cities, such rail frequently has to be renewed every five years, and the cost of these new rails must be charged to operating expenses. Less superfluous metal is desired.

The weakest part of a piece of track is naturally its joints, and several forms of good joints are now on the market and in use, with a resulting power to increase the life of the track.

Improvements in cast-welding the joints have also lowered the depreciation factor.

Mr. Hodges then described the forms of special work of earlier days. The older types of switches, frogs, mates and curves were made of cast iron in lengths not exceeding 8 ft. This was because good castings could not be made larger. Early switches were straight, making an angle of about 4 degs. with the main line. The paper closed with a brief sketch of the improvements which have been brought about by the use of steel special work with hardened centers.

A brief discussion followed the reading of Mr. Hodges' paper. In reply to a question by R. W. Conant, of Cambridge, Mass., Mr. Hodges stated that in his opinion the principal difficulty with 60-ft. rails on either steam or electric roads is the trouble experienced in maintaining good and true alignment under all conditions of weather. Even on an interurban track in the West which was carefully laid with 85-lb. rails, the joints could all be seen in hot weather upon looking down the track, and where the joints were staggered it was very difficult to prevent noticeable lurching of the cars from side to side. Mr. Conant then brought out the point that the bond problem is reduced one-half by the 60-ft. rail.

The next speaker was David Curtin, roadmaster of the Boston & Northern and the Old Colony Street Railways. He devoted most of his time to a resume of the Twin City Rapid Transit Company's systematic work in track problems. The Twin City Company was first operated as a street railway about thirty years ago as the St. Paul City Railway and the Minneapolis Street Railway. A large number of different rail sections have been tried by the company, beginning with a 25-lb. T-rail, and gradually working up to the present standard, which is a 79-lb. T. In the Twin Cities the streets are wide and the tracks do not receive the usual enormous wear and tear due to regular street traffic—at least not to the extent found in many other large cities. The conditions are naturally much different from those which obtain in the East. Single-ended cars are used exclusively on the Twin City system. Considerable trouble arises from the fact that the sewer, gas and water connections are not usually put in until after a street is paved. The ties in use are 8-ft. white pine sticks, obtained from the neighboring lumber mills along the banks of the Mississippi. Crushed rock, cement and sand are hauled to the site of the work by the company's own cars. The company owns its own sand pit, and there is no record on the books of its ever having bought sand of outsiders. The work cars carry 15 cu. yds. of crushed stone, each.

The first cast-welding of joints by the Twin City Company was in 1894. The first track that was cast-welded was a 78-lb. rail on Washington Avenue, Minneapolis. It was badly worn, but as an instance of what cast-welding will do to prolong life, it may be stated that the rail lasted until 1903. Mr. Curtin said that the cost of cast-welding track is extremely variable, depending upon local conditions, and also upon whether traffic had to be maintained upon the line while the work was going on. The company now owns a number of welding machines, and it has from 75 to 85 miles of welded track in service. Great care is essential to the performance of good work in cast-welding. The joints are tested by a steel straight edge. Close attention had to be given to every detail, and the shimming up of the rails had to be particularly looked after. Albert B. Herrick has stated that the conductivity of the joint is from 25 per cent to 50 per cent above that of the rail. Concrete and wooden block construction is used between the track rails. Not over 1 per cent to 1½ per cent of the joints break. The concrete is put in to a depth of 10 ins. below the base of the rail and carried up to within 1½ ins. to 3 ins. of the head. Domestic concrete, Milwaukee or Mankato, is used between the tracks in city construction. After the concrete is down, the wooden blocks are put in at a cost of 6 cents each for cutting. The rail resembles a grooved rail. The small groove is effective in keeping teams out of the track. [Another factor that helps in the matter of keeping the tracks clear is the location of the poles carrying the feeders and trolley wires between the double tracks, instead of the common span construction.—Eds.] Wooden blocks were used for flanging on account of the short life of asphalt and concrete.

On the interurban and suburban lines an 80-lb. A. S. C. E. pattern T-rail is used with 8-ft. ties and continuous joints. At present there are two interurban lines between Minneapolis and St. Paul, one 10 miles and the other 11 miles long. The direct line runs via University Avenue, and the longer one via Como Park. A five-minute service is given on the University Avenue line, and in the rush hours this is increased to two and one-half minutes between cars. The company is planning two other interurban lines between the two cities; one to go via Fort Snelling and the other via the Marshall Avenue bridge across the Mississippi through the Merriam Park residence district. Subways for foot passengers are used at some of the parks, so that the tracks may be kept clear, and the length of track on the system aggregates about 280 miles.

Mr. Curtin then described the interurban line between St. Paul and Stillwater via White Bear Lake, and closed with a careful and detailed description of the counterweight system used by the company on the 16 per cent grade of the Selby Avenue line, which has a 150-ft. radius curve at the bottom of the hill.

In view of the lateness of the hour, President Neal then stated that Mr. Curtin's and the following paper would be open for discussion together, and H. M. Steward, roadmaster of the L division of the Boston Elevated Railway Company, was introduced.

Mr. Steward began by giving some of the principal statistics of the elevated division. The main line from Dudley Street to Sullivan Square is 6.5 miles long, the Atlantic Avenue section being used only by loop trains. The total mileage of elevated track is 16.015, of which over 40 per cent is made up of curves. The radii of these curves vary from 80 ft. to 5000 ft. There are eighteen curves below 100-ft. radius; a passenger describes 9.43 circles in making a round trip, and there are two up and two down grades of 5 per cent, where the tracks connect with the subway. At this point there is also an 8 per cent grade. The subway is the worst part of the road to operate; it was never intended for elevated train operation to the exclusion of surface cars, and it is often impossible on account of clearance to give the rails the necessary super-elevation on curves. Mr. Steward then described the track construction on the elevated structure, which is familiar to our readers from previous published accounts. The running and third rails are 85-lb. sections, and the guard rails on curves weigh 100 lbs. per yard. The paper thoroughly described the bonding, signal-block rail, bolts, tie plates, spikes, etc. The maximum elevation on curves is 4 ins., the elevation beginning at the tangent point. There are 120 frogs and 86 switches on the division. Of these switches, 55 are operated by towers.

Mr. Steward then took up the question of maintenance. The rails of the Boston Elevated wear faster than on any other railway known to the transportation world. The experience of the company is unique, and it exceeds anything that the past has recorded. This terrific wear is attributed to the sharp curves, grades, combinations of each, and to the large number of motor cars per train. On account of the heavy grades, each car is obliged to be propelled by its own motors. Power enough is supplied in the equipment to enable a motor car to haul another dead car up the 5 per cent grades, but this is not done except under stress of emergency, on account of the danger of such a train becoming stalled. Most other elevated roads have one trailer per motor car, and consequently suffer from but one-half the grinding friction experienced on the Boston Elevated.

The first rails ordered were of the same character as ordinary steel rails for steam road operation. Nothing like the enormous wear and tear which resulted was expected. From experience with these first rails, they came to be known as "soft rails," with a low percentage of carbon. It was found that some of the rails in the same curve resisted wear better than others; chemical analyses were made and new specifications drawn. The company now has a steel rail which lasts on the average three times as long as the early commercial rails which were used, and the first cost is about the same. A large number of experiments with rails have been made, as the company was and is willing to try anything which is safe. It was thought at one time that a nickel-steel rail would show less wear than other types which had been tried, and one was laid between two hard Cambria rails on the outside of the northbound track in the 100-ft. radius curve at Haverhill and Conseway Streets, just beyond the North Station. In 204 days the rails were removed on account of difference in wear. It was found that the higher cost nickel-steel rail had worn down .044 ft., against but .015 ft. in the case of the Cambria rail. The manufacturers could not believe that a mistake had not been made until they sent their own representative to the spot. A soft steel rail placed in the track on the southbound curve of 82-ft. radius at Park Street Subway Station lasted on the average just forty-four days, and in that time the wear was from .050 ft. to .064 ft. Manganese rail was put in the track in April, 1902, and is still in. It has been in place nearly 1000 days, and shows a top wear of only about .016 ft. The manganese rail has a large amount of side wear as compared with top wear. While manganese steel will stand rolling friction indefinitely, it will not stand up nearly as well under the grinding, cutting friction from the flanges. This rail is not now allowed to take all the flange wear, but is protected by a steel guard rail, which is greased several times a day. There are now about 475 ft. of manganese steel rail, three sets of crossing frogs and several ordinary frogs in the elevated tracks.

The average life of the rail on curves is from four to six months. Improvements in the rail composition have brought down the average amount of new rail laid per month from 6100 ft. to 3500 ft. On curves of 500-ft. radius, the wear is smooth and even, and on 1000-ft. radius curves it is extremely even. On curves with a radius above 1000 ft., the rail does not wear entirely out, as it is obliged to be renewed on account of the corrugations which form in it. The original rails are still in service on the tangents of the elevated division.

Slippage of the wheels causes the grinding of deep holes in the rail surface. If the action was kept up long enough the rails would readily be cut in two. For this reason every effort is made to prevent trains from becoming stalled, especially on grades.

Mr. Steward then took up the question of inspection and repairs. At least once a month the rails on each curve are measured, and this is done oftener as the rails begin to be well worn. On a steam road it is often the case that rails will be kept in service several years after the roadmaster has recommended new track, and even then one seldom finds a rail that cannot be used to advantage on some branch line or siding. Such a policy as this would be impossible on the Boston Elevated, because when the rails begin to get seriously worn it is a matter of weeks or days instead of months and years before replacement is absolutely necessary, and then the rails are only good for scrap, on account of the terrific wear to which they have been subjected.

The results of all these rail measurements are carefully plotted and analyzed. Mr. Steward stated that he knew of no other road which does this sort of work.

Track inspection is cared for by two crews of track walkers, aggregating eleven men. There are two foremen, and each track walker looks after about 1½ miles of track. These men work in the day time, and are unable to make any except the lightest repairs, such as tightening bolts. They also grease curves. They are obliged to look out for the trains on the one hand and the third rail on the other, so that they pass few idle or secure moments while on duty. All the repairs of consequence are done at night, between 1 and 5 a. m. A large crew is at work repairing track six nights of every week. The work on new rails is practically all done in the yard at Sullivan Square by a crew of six men and a foreman. This covers cutting, curving, punching and drilling. The rails are so hard that they are bent by hand instead of by machines, to reduce the danger of breakage.

The work train consists of a motor car and one or more flat cars carrying the requisite tools and supplies. Among these is a derrick with a 20-ft. boom. The motor car may be operated either by trolley or third rail. This is a great convenience at times when it is necessary to cut the current off from the third rail while the crews work. Underneath the structure is generally a surface car trolley which can be tapped for power, even when the third rail is shut off. In this way the work train can readily be moved.

Throughout the entire length of the structure and subway runs a 2-in. pipe line carrying compressed air. While this is largely used to operate the electro-pneumatic block signals and the interlocking switches and signals, it is also a great convenience to the repair crews, who use it in operating drills, chipping hammers, grinding machines, blowing out switches, etc.

Unlike the situation upon most steam roads, the traffic cannot be diverted for the purpose of repairs. Rails or ties cannot be renewed in the day time. It takes two men at a claw-bar to pull a single spike. Screw spikes would be out of the question on account of the time it takes to drive or draw them. The best twist drills had to be reground after drilling nearly every hole or two at first, but now a flat diamond pointed drill is used which drills fourteen holes with one grinding. The laying of twenty rails is considered a good night's work for the repair crew of twenty-five men.

The third rail requires comparatively little attention contrasted with the service rails, but the insulators have to be looked after closely to prevent short-circuits and burn-outs. The collecting shoes wear the third rail somewhat, but the steel sleet brushes wear it more. Spikes and bolts are constantly being loosened by the vibration of the structure. The great point kept constantly before all the repair crews is the absolute necessity of the road's being ready for business each morning. Nothing else stands before this.

In the brief discussion which followed, Mr. Orr, of the Boston & Maine steam road, stated that he had observed a similar case of a rail's having a hole ground in it by the slipping of locomotive drivers in the Hoosac tunnel.

The meeting closed with a unanimous vote of thanks to the three gentlemen who had contributed to make the occasion interesting and profitable by preparing papers.

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The broad possibilities of freight service on interurban roads have been illustrated by Cleveland roads recently. A few days ago the Northern Ohio Traction & Light Company handled a car load of horses from Akron to Cleveland, this being one of the first instances in which live stock has been brought into the center of Cleveland by an electric road. Recently the Lake Shore Electric Railway handled a remarkable shipment. It consisted of a traveling menagerie, which included two trained donkeys, two deer, a kangaroo, two coyotes and a large black bear. The load was shipped from Cleveland to Lorain, and it was necessary to store the animals in the express station over night. The bear got loose and made things lively for the station agent when he entered the building next morning. As a result, the company will decline to handle bears in the future.

## THE WESTINGHOUSE SINGLE-PHASE, A. C. RAILWAY SYSTEM FOR INTERURBAN SERVICE

The rapidity with which old standards are replaced by new, and the slight extent to which electrical practice is hampered by tradition or adherence to established methods, find example in the complete change in sentiment regarding the possibilities of the single-phase series motor for traction purposes that has taken place since B. G. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, first made public the results of his researches along this line. Three years ago, European engineers were devoting their efforts to overcoming the inherent defects of the polyphase motor for railway service, and had, evidently, finally decided to use polyphase systems. American engineers were decidedly skeptical as to the ability of any one to produce an alternating-current railway system that could be operated economically or satisfactorily, or alternating-current motors with the proper characteristics for railway service. This was shown by the many doubts expressed at the meeting of the American Institute of Electrical Engineers, Sept. 26, 1902, where Mr. Lamme presented his first paper. To-day the general verdict is that the alternating-current railway system is not only entirely practicable, but that it is destined to come into very general use for traction purposes.

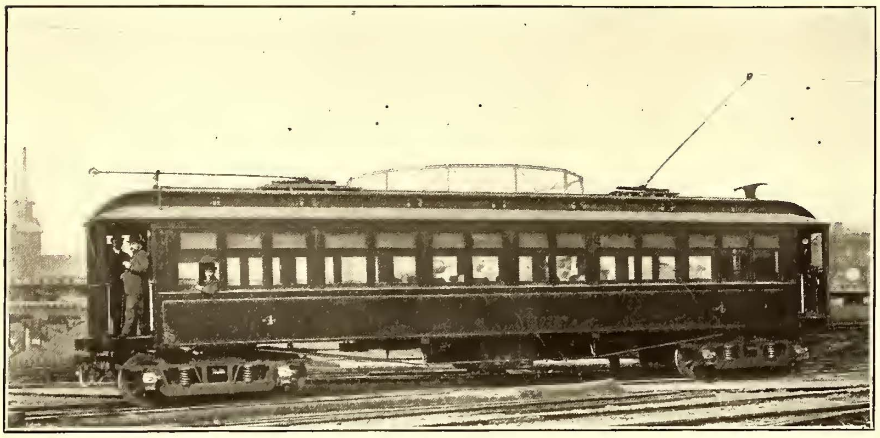


FIG. 1.—CAR ON THE INTER-WORKS RAILWAY EQUIPPED WITH A. C. APPARATUS. TROLLEY AND LINE CONSTRUCTION FOR 1000 VOLTS AND LESS

The alternating-current railway motor is not a new and untried experiment. Previous to 1902, when Mr. Lamme first publicly advocated the use of single-phase alternating current for railways, a long series of tests at the Pittsburg shops had demonstrated the value of the series alternating-current motor. In addition to these, a number of 40-hp motors of this type had been operated continuously for nine months in a certain outside manufacturing plant. Since that time the Westinghouse engineers have been actively engaged in perfecting the details of the other apparatus required to complete the system. For nearly two years a car equipped with these motors has been in almost daily use upon the Inter-Works Railway between East Pittsburg and Wilmerding, and system of regulation and control suited to various operating conditions have been devised.

The Westinghouse single-phase motor was described in the issues of this journal for Dec. 26, 1903, and Jan. 23 and March 26, 1904, and in the two latter numbers some diagrams and particulars were given of the control. Certain slight modifications of the latter have been made since that date, so that it has been considered advisable to describe briefly the system of control and wiring as it exists to-day. Of the motor, it is sufficient to say that it possesses the same speed and torque characteristics and practically the same weight per horse-power as the best direct-current motors now in use. It is, in effect, a straight series motor, carefully designed for use on alternating current. The chief reason for its prominence is not in the motor per se, bue in the fact that its development allows the use of alternating current throughout the entire system.

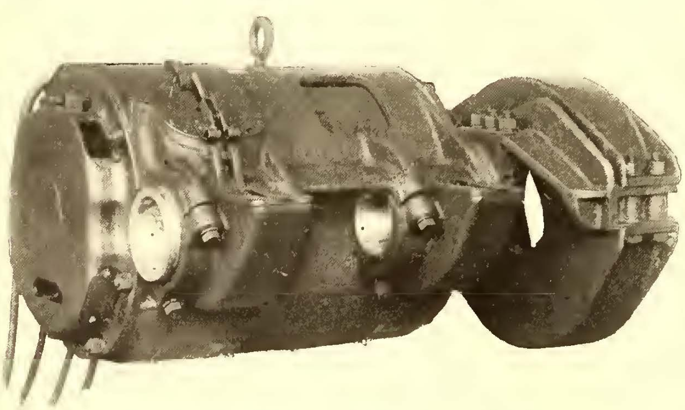
### CAR WIRING

There are three electric circuits upon each car, as shown upon the accompanying diagram, Fig. 4, viz.:

(1) The Motor Circuit.—In this circuit there are placed the circuit breaker, main transformer, induction regulator, reverser, motor cut-out switches and motors.

(2) The Auxiliary Control Circuit.—An electro-pneumatic system of control is used, the various parts being operated by compressed air controlled by magnet valves. Current for the magnet valves is obtained from a 14-volt storage battery placed under the seat of the car. The use of a separate low-voltage circuit for this service is a valuable factor of safety. The fact that the control circuit is independent of the line, and can be used whether the trolley is in use or not, is also an advantage.

(3) The Lighting and Heating Circuit.—This contains the necessary apparatus for lighting and heating the car and, also, the air-compressor motor with its governor. It is taken from the line by a second transformer. This circuit is not connected with the motor circuit.



NO. 2.—NO. 106 A. C. RAILWAY MOTOR

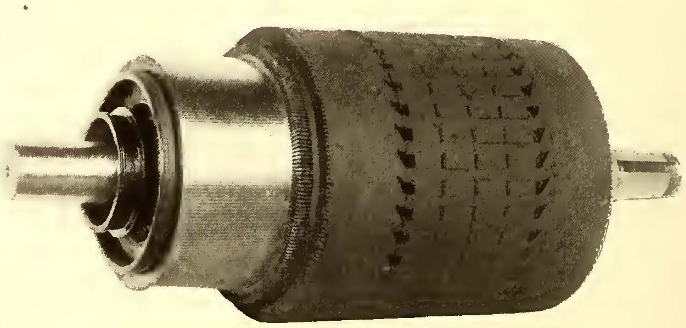


FIG. 3.—ARMATURE OF NO. 106 A. C. RAILWAY MOTOR

### MOTOR CIRCUIT

The motor circuit begins with an auto-transformer of special design connected between the trolley wire and the ground. This transformer is so arranged that the current of air created by the motion of the car circulates through it, thus keeping it cool. A view of this transformer as mounted beneath a car may be seen in Fig. 6. At a point approximately 230 volts from the ground, a circuit is led from this auto-transformer through the secondary of the induction regulator, and another tap, approximately 650 volts from the ground, is led through the primary of the regulator. The exact wiring of this arrangement may be seen in Fig. 4, and the diagrammatic arrangement in Fig. 7, which is somewhat modified for greater clearness. Between the auto-transformer and the trolley is placed the circuit breaker, which is held in place by a compressed air cylinder working against a powerful spring. When the air is allowed to escape, the spring opens the breaker. The admission or release of air from the pneumatic cylinder is controlled by means of magnetic valves. The induction regulator which governs the voltage is applied to the motors, and consequently the speed of the car is regulated by means of a small pneumatic motor controlled by electro-magnetic valves, and may be turned so that its voltage either opposes or aids that of the auto-transformer, any amount within the capacity of the regulator. In the "off" position, the full voltage of the regulator is opposed to the 230-volt circuit of the auto-transformer, thus giving a low voltage for starting the motors. At the "full-on" position the entire voltage of the regulator is added to that of the 230-volt circuit of the auto-transformer, giving the proper voltage for full-speed running. The regulator can be left indefinitely in either of these, or in any intermediate position, and thus the car can be run at any desired speed. The reverser is operated by means of two pneumatic cylinders, one throwing it forward and the other backward. Air is admitted to either cylinder when desired by means of a magnetic valve. The motor cut-out switches consist of a double-pole switch for each motor, all mounted together and enclosed in a suitable iron case. In case of damage to any motor, the injured motor can be cut off entirely from the circuit, and the car then operated with the remaining motors.

The motors are permanently connected in parallel, the advantages ordinarily derived from a series-parallel arrangement being obtained directly through the use of different positions of the induction regulator, without changing the connections of the motors with respect to each other. As the motor voltage is independent of the trolley voltage, a standard of 250 volts has been adopted, irrespective of the voltage of the trolley.

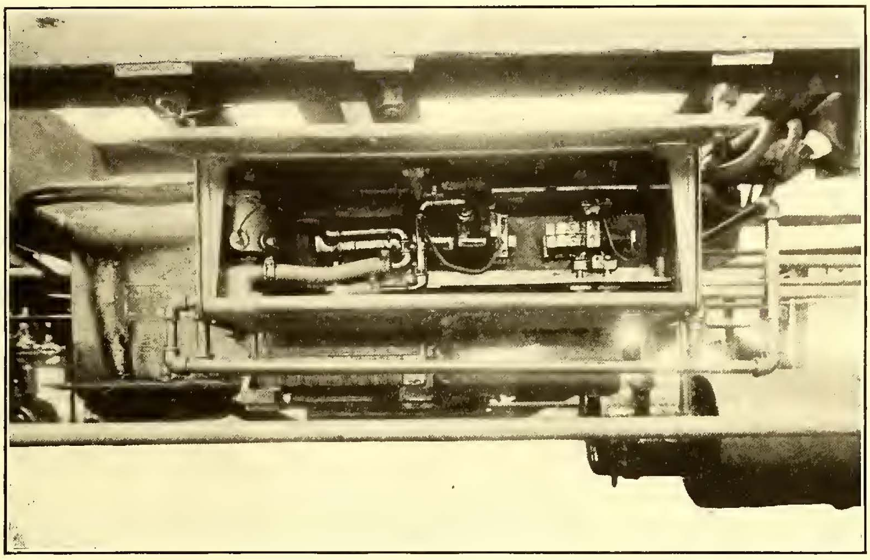


FIG. 8.—CIRCUIT BREAKER AND AUTO-TRANSFORMER ON CAR EQUIPPED WITH A. C. SINGLE-PHASE APPARATUS

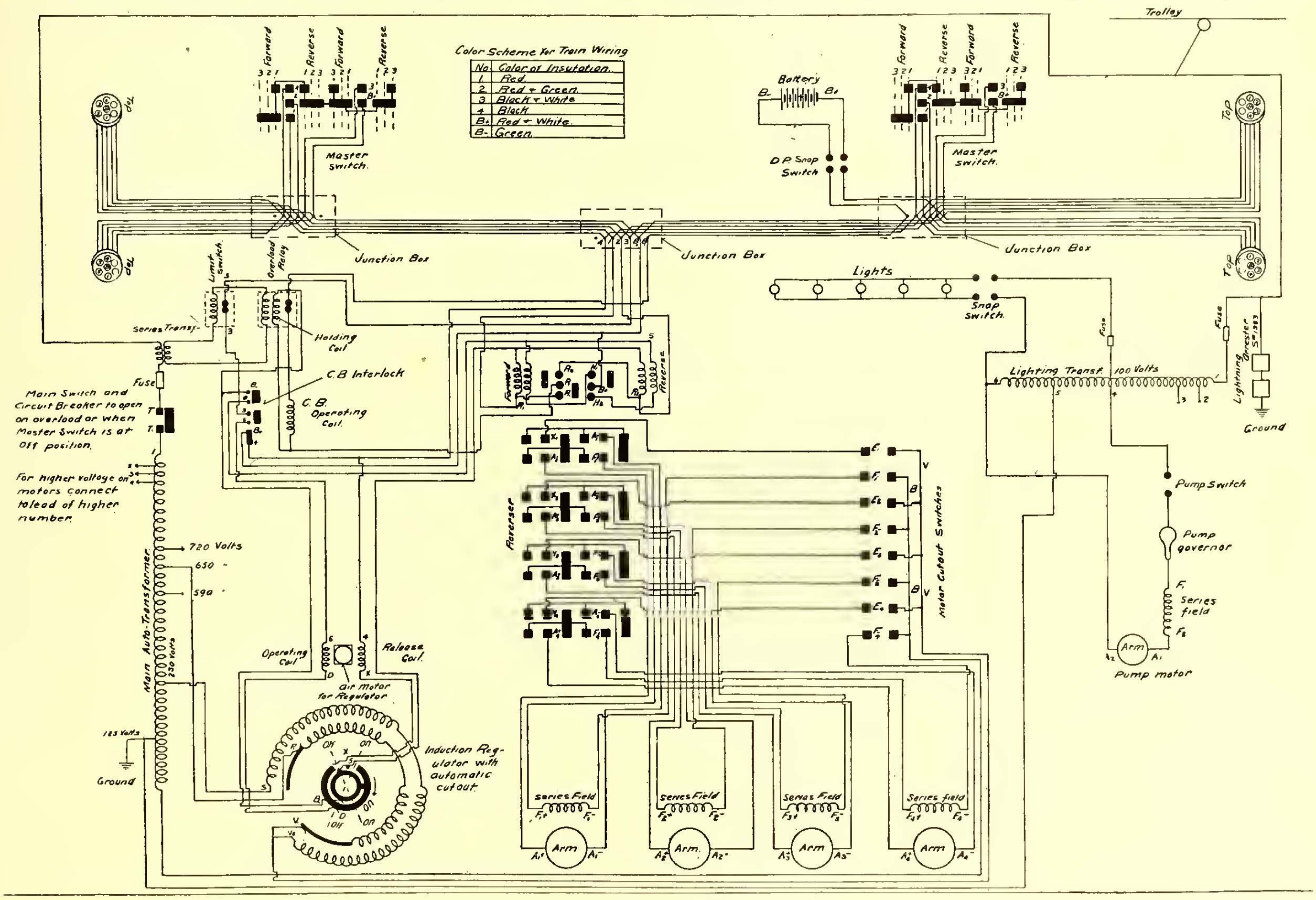



FIG. 4.—WIRING DIAGRAM OF WESTINGHOUSE A. C. SINGLE-PHASE CAR EQUIPMENT

CONTROL CIRCUITS

The operation of the various magnet valves which regulate the movement of each of the above pieces of apparatus is controlled by means of a master switch located on the platform of the car. A view of this switch, together with the motorman's air-brake valve, may be seen in Fig. 5. There are but three positions for the handle of the master switch for operating the car in a forward direction, and three corresponding positions for backing. When the handle is turned to the first notch on either side, connection is made with the magnet valves governing the reverse switch. Air is admitted to the proper cylinder and the reverser thrown to the proper position. When the reverse switch has been operated, air is then admitted to the pneumatic cylinder of the circuit breaker and the circuit breaker is then closed. This admits the current directly to the motors and the car starts.

To secure a higher speed, the control handle is thrown to the third notch, which closes the circuit to one of the magnet valves controlling the pneumatic motor which drives the induction regulator, and air is thus admitted to the air motor. The regulator is then turned, gradually raising the voltage at the terminals of the motors. If the handle of the master switch is left on the third position, the regulator will advance to the "full-on" position, where it will be automatically stopped. If it is desired to operate the car at anything less than full speed, the handle of th^ master switch may be brought back to the second position, and the regulator will at once stop and remain stationary. Under such circumstances, if the handle is again moved to the third position, the regulator will advance and increase

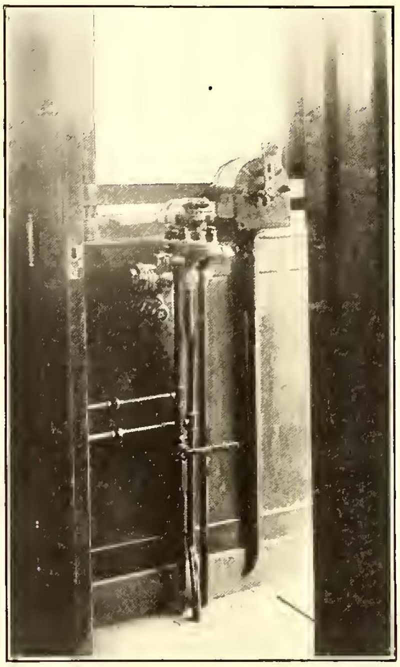


FIG. 5.—CONTROL APPARATUS IN CAB FOR SINGLE-PHASE CAR EQUIPMENT

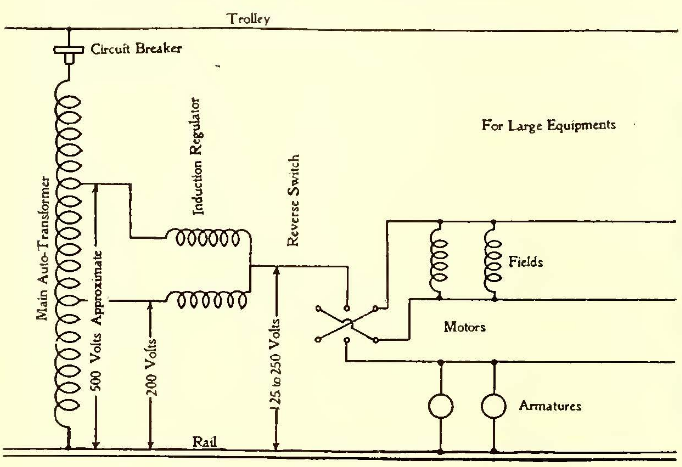



FIG. 7.—DIAGRAM OF MOTOR CIRCUIT

the voltage at the motors and, consequently, the speed of the car. If the handle is moved back to the first position, the regulator will return toward the minimum position, lowering the voltage on the motors, thus lowering the speed of the car. If at any time it is desired to cut off the current, the handle of the master switch may be returned to the "off" position, in which case the circuit breaker will open at once, thus cutting off the current immediately. After the circuit breaker has been opened the regulator will return toward the minimum position, and the circuit breaker having once been opened cannot be closed again until the regulator has reached the position of minimum voltage.

The circuits leading to the circuit breaker and reverser are so inter-connected that the circuit breaker cannot be closed until the reverser has first been thrown, nor can the reverser be moved unless the circuit breaker is open.

The arrangement described can be adopted for multiple control by the addition of leads, connection boxes and "jumpers" for forming a continuous-control circuit over the different cars,

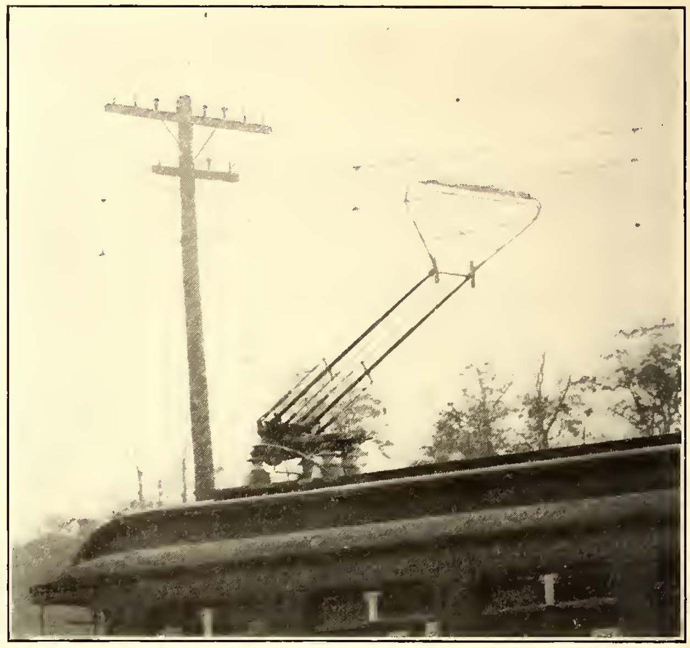


FIG. 9.—WESTINGHOUSE BOW TROLLEY MOUNTED FOR SERVICE

no other change being necessary. The advantages of this method of speed control, as compared with rheostatic control, are evident. The elimination of resistance losses, the ability to change speeds without opening the circuit, the fact that every speed may be used for continuous run-

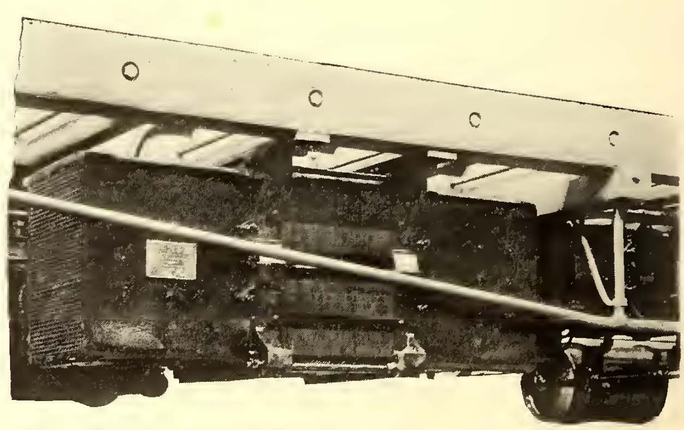


FIG. 6.—AUTO-TRANSFORMER IN MOTOR CIRCUIT ON CAR EQUIPPED WITH A. C. SINGLE-PHASE APPARATUS

ning, and the ease and flexibility of control are important benefits thus derived.

LIGHTING AND HEATING CIRCUIT

The lighting and heating circuit is operated from a small auto-transformer similar in design to the one in the motor circuit. From this transformer are supplied the lights in the car, the heating circuits—if any—and the small motor for operating the air compressor. The latter may be controlled by an automatic governor or by the hand switches, which are conveniently located.

TROLLEY AND OVERHEAD WORK

Where the voltage of the line is 1000 or less, connection between the car and the trolley wire is established by means of a trolley of the ordinary type. For higher voltages, a trolley of the bow type, especially designed for the purpose, is used. This is raised and lowered by compressed air under the control of the motorman, and any danger from shock in handling is thus avoided. In Fig. 9 it is shown in the running position. The two levers at each side are so arranged that when the pneumatic pressure is removed the trolley lies flat upon the top of the car. When the air is applied, the result is first to raise the upper section at about the angle illustrated, and then to lift the entire trolley to the running position. The main spring keeps the trolley upright, but permits it to give under pressure. When the direction of the car is reversed, the upper portion of the trolley is slanted in the opposite direction. The side springs in the levers, which support the upper portion of the trolley, adjust it for variations in the height of the wire, and the trolley is thus kept in contact with it, and a continuous unbroken current results. With ordinary variations, the position of the lower portion of the trolley remains unchanged, the fluctuations affecting only the lighter upper section and insuring a sensitive action. The chief advantages given by the trolley are the substitution of pneumatic for hand control, with the consequent elimination of all danger from grounding through the hand rope; a continuous contact with the trolley wire and the impossibility of the trolley slipping off the wire and damaging the overhead structure.

At each support the trolley wire is attached at a point alternately 12 ins. to right and left of the center of the track, so that it is staggered, and the contact between it and the trolley varies from one side to the other, and thus undue wear at any point is prevented.

The overhead structure, which is of the catenary type, is shown in Fig. 10, showing two spans upon the Inter-Works Railway. The trolley wire is suspended from a messenger cable by hangers of different lengths, so graduated that the wire is at all points parallel with the track, presenting the best possible condition for continuous contact under high speeds. This construction also gives a greater rigidity, with the absence of up-and-down or sidewise motion, an increased strength, and consequent ability to support loads of ice in winter storms; and strength and simplicity in all parts that minimizes repairs, and, in general, an efficiency in keeping with other portions of the system. This catenary structure can be suspended from side brackets, as shown, or the ordinary span construction can be adopted. Grooved trolley wire is used, and since it is supported at frequent intervals, great rigidity can be obtained with a small size of wire. Suitable details of construction for use upon curves of different radius, of anchors, steady strains, section breaks, turn-outs, etc., have also been carefully designed.

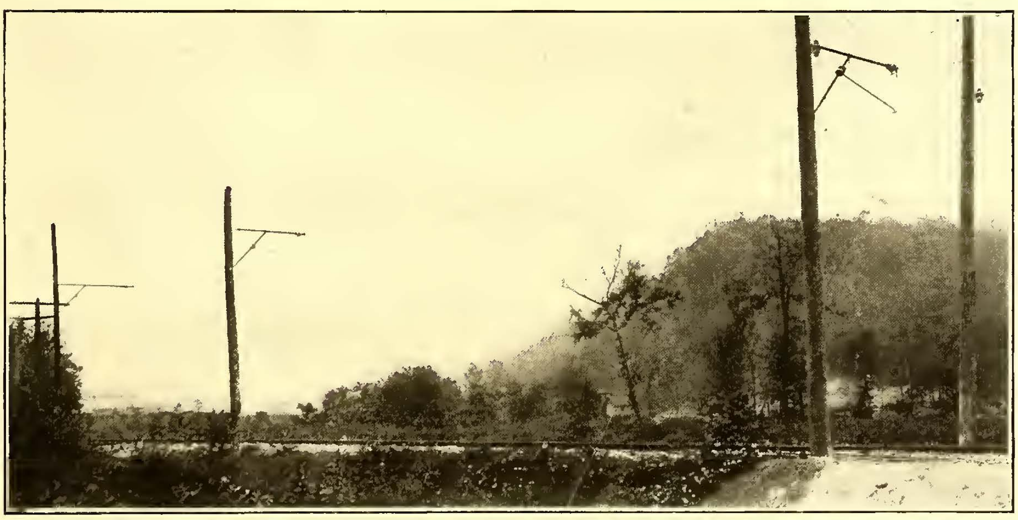
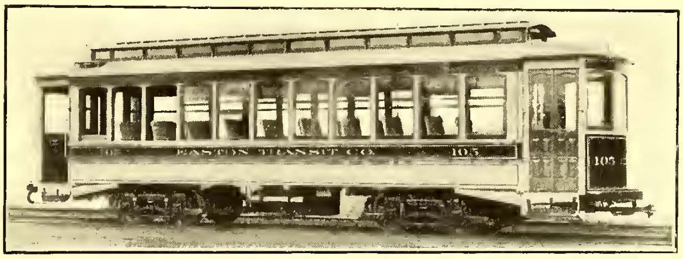


FIG. 10.—CATENARY TROLLEY LINE UPON INTER-WORKS RAILWAY

A study of the system, as briefly outlined, shows a consistency in theory and design which has been followed throughout the different pieces of apparatus, and which produces an unusual degree of efficiency and general harmony. The field for development is a wide one. The way is also opened for the adoption of the system in city service, where perfect control in conjunction with economical consumption of energy in starting, are of particular value, and for its use also in heavy units, such as now are confined to steam railroads.

## SEMI-CONVERTIBLE CARS FOR EASTON, PA.

Three semi-convertible cars like that illustrated were delivered last week to the Easton (Pa.) Transit Company by the J. G. Brill Company. They are of the builders' well-known type



EXTERIOR OF SEMI-CONVERTIBLE CAR OPERATED BY THE EASTON TRANSIT COMPANY

and the first of the kind ordered by the company. They are for use on a division of the extensive system operated by the company between Easton and Bethlehem, a distance of about 12 miles. The country traversed by this division is mountainous and there are a number of heavy grades. On one of these grades, which is 9 per cent, is a curve of 50-ft. radius. Steam road traffic has almost entirely been diverted to the electric line, and a large and rapidly increasing business is being done. Both cities are in a very flourishing condition and their large manufacturing interests are allied in many ways. Easton has a population of over 25,000, and Bethlehem nearly 10,000, and each is the center around which is grouped a number of busy smaller towns. The system includes the lines at Palmer, Butztown, Northampton, Phillipsburg and Freemansburg, and connects these places. Oakland Park, a finely situated amusement resort, is controlled by the company.

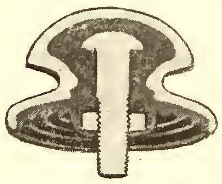
The roadbed of the entire system has lately been reconstructed and heavier rails laid. The overhead construction has also been replaced by heavier material. The new cars are shorter and lighter than those that have been in use, as it is the intention to reduce the power required per car and increase the number of cars. This type of semi-convertible car is well suited to such a policy, as the construction is not as heavy as ordinarily, less cross section of material being required in the sides. One of the new cars mounted on trucks with four motors of 40-hp each, and electrical equipment, weighs 39,244 lbs. The trucks are Brill No. 27-G type, capable of a speed of 35 miles per hour, and as they carry the car body low are used to advantage under such cars on short interurban lines. The type of car and the details of its window system are too well known to need description. Several windows of the car illustrated are raised into the roof pockets, and others are at different heights, showing that passengers may have as much air as they desire. Attention is also directed to the high roll-top reveısible-back seats and the neat arm rests on the low window sills.

The interior of the cars is simply but handsomely finished in cherry; ceilings are decorated birch veneer. The seats are upholstered in spring cane, and arc 36 ins. long, the aisle being 24 ins. wide. The length over the end panels is 30 ft. 8 ins., and over the vestibules, 40 ft. 1 in. The width over the sills and panels is 8 ft. 1½ ins., and over the posts at the belt, 8 ft. 4 ins. The height from the floor over the window sills is 24⅝ ins., and the sweep of the posts, 1¾ ins. The corner posts are 4¾ ins. thick, and the side posts, 4¼ ins. The side sills are of long-leaf yellow pine, 4 ins. x 7¾ ins., and 12-in. x ⅜-in. sill plates on the outside, to which the bases of the posts are attached. The end sills are of white oak, 5¼ ins. x 6⅞ ins. Brill channel-iron draw-bars, angle-iron bumpers, ratchet brake handles, Dedenda platform gongs, retriever conductor's bell and sill arm rests are among the builders' specialties with which the cars are equipped.

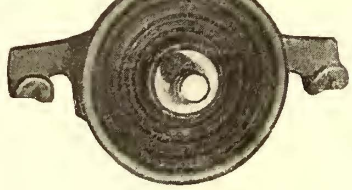
## HIGH-TENSION TROLLEY INSULATORS

It will be of interest to prospective users of the single-phase a. c. trolley system to find a line of trolley insulators particularly designed for this high-pressure trolley work, with a view of securing the very highest insulation and at the same time maintaining a very simple and well tried design. The types of insulators illustrated herewith are manufactured by the Creaghead Engineering Company, of Cincinnati, Ohio, and are known as the "Armored Cap Cone" type.

Insulator No. 1370 is a straight line hanger, consisting of two

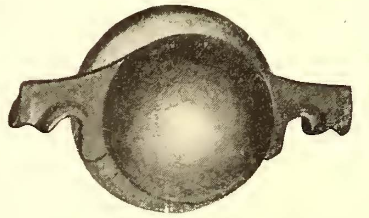


SECTION OF NO. 1371



NO. 1370.—BOTTOM VIEW

NO. 1371

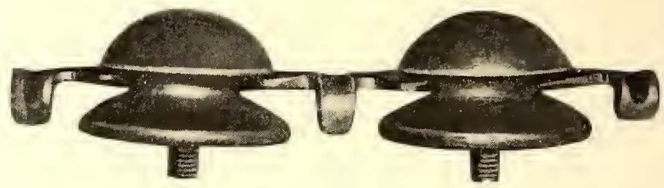


NO. 1370.—TOP VIEW

parts, namely, No. 1371 interchangeable insulator body, and the No. 1369 single malleable yoke used to attach this insulator body to the span wire. The mechanical points that were kept in view in the design of this insulator are simplicity, strength and absence of the usual parts that are liable to shake loose on the line. The manufacturers have used the form of yoke No. 1369, which is similar to a yoke that they had used for many years for attaching the insulator to the span wire. This form is used so that a flexible grip can be secured by the combination of the span wire with this yoke, and so that the insulator body cannot shake loose. Tests show that the ⅝-in. stud breaks at about 14,000 lbs. The stud breaks and will not pull out of the insulator under this strain. The general shape of this insulator is similar to the old "cap and cone," but the diameter of the skirt is much greater and the design is very much improved. In the design for insulation the following points were carefully provided for: insulation to prevent puncture at high pressure, high surface resistance and a very large spark gap between the stud and shell.

In test it has been found that the insulation is much higher than the demand of the work would require, and the spark gap is set just to protect the insulation from puncture. Under test the pressure of 24,000 volts will cause the current to jump the

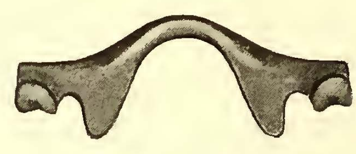
NO. 1372.—DOUBLE YOKE



NO. 1373.—HANGER

air gap from the shell to the stud under the bottom of the insulator, but still leaving the insulator intact when the arc is broken. These insulators are for use on lines up to 3000 volts.

For double-trolley wire work the No. 1373 hanger is used. This hanger is very simple in design and consists of only three pieces, the double yoke No. 1372 and two interchangeable insulator bodies No. 1371. While this insulator is especially designed for high-tension work, it is intended for use on the ordinary direct-current trolley system, and its shape is such that it could be used for repairs on lines using cap and cone insulators and presenting practically the same appearance as the cap and cone insulator. The fact that the insulator body does not shake loose is the great advantage over the "cap and cone" design. The general design is such that the hanger is primarily an insulator, and a considerable quantity of insulating compound is used. The cost of the insulation is a large factor in the cost of the hanger. Special machine work and



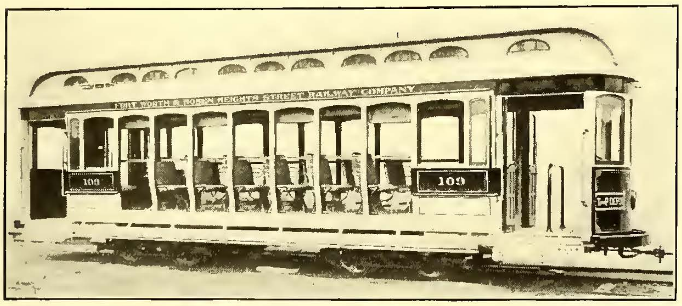
NO. 1369.—SINGLE YOKE

expensive processes in the manufacture, as is the case with the West End form, is avoided. The greatest value of a trolley insulator lies in its insulation and in a simple and substantial method of protecting and supporting this insulation. The "Armored Cap Cone Insulator" will meet the most severe trolley conditions.

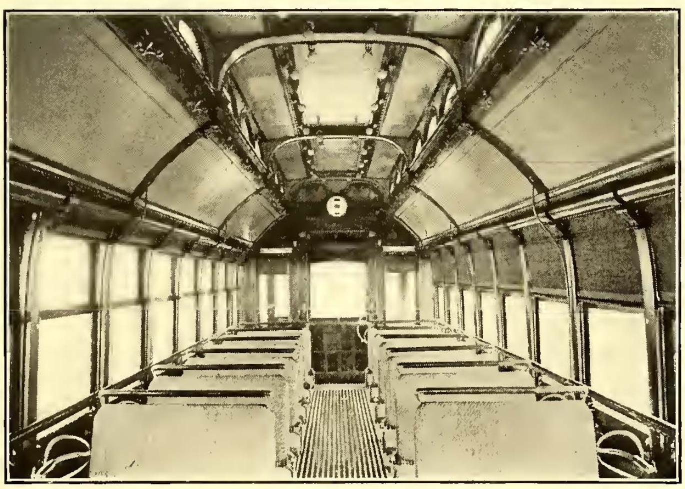
A striking instance of the inroads being made by electric railways on the business of the steam roads is furnished by the present traffic enjoyed by the former in county and State fair freight, notably race horses. An interurban official, in speaking of the matter, said that the increase of that class of business on the traction lines is really remarkable. He attributed it not only to the fact that the cost is less, but that the horsemen appreciate the absence of bumping which is experienced in the switching of cars on the steam lines, which at times is sufficient to throw the horses from their feet.—Columbus "Citizen."

## CONVERTIBLE CARS FOR FORT WORTH

The Fort Worth & Rosen Heights Street Railway Company has lately received four convertible cars from the American Car Company, of St. Louis, which have several features unusual with this type of car. The cars are built under the Brill patents. The vestibuled Detroit platforms are among the interesting features of these cars. They are 5 ft. 6 ins. long, and are well supported by platform timbers reinforced by angle iron, and by angle-iron center knees which extend well back of the body bolsters. An automatic device controls the movement of the vestibule doors, preventing them from striking the dividing rail. The vestibule sashes are composed of single lights, and are arranged to drop into pockets. The sashes and panels of the car are raised into roof pockets when not in use. Corner seats for three persons each are provided by extending the fixed panels from the double corner posts to the first side posts. The seats are of the step-over type, and provided with brackets between the backs and the side posts, which serve as grab handles, making it unnecessary to use grab handles on the outside of the posts. The seating accommodation is provided for thirty-six passengers. The guard rails slide on guides on




FORT WORTH CONVERTIBLE CAR, OPEN



INTERIOR OF FORT WORTH CONVERTIBLE CAR

the inside of the posts, and may be seen in the interior view in a lowered position. A pleasing effect is obtained for the roof by a recessed dome, in which the incandescent lights are placed. The ventilators are arched and the general style is semi-empire. The birch veneer, neatly decorated with gold, comprises the headlining, and the interior finish is of cherry, natural color. This is the first lot of convertible cars to be built with steam car roofs and semi-empire treatment of deck.

The cars are 25 ft. 9 ins. long over the end panels, and 36 ft. 9 ins. over the crown pieces; width over the sills and sill plates, 7 ft. 9¼ ins., and over the posts at the belt, 8 ft. 4 ins.; sweep of the posts, 3⅜ ins.; distance between the centers of the posts, 2 ft. 7 ins.; thickness of the corner posts, 3¾ ins., and of the side posts, 3⅜ ins. The side sills are 4¾ ins. x 6¾ ins., and the end sills the same size. The sill plates are on the outside and are 8 ins. x ⅝ in. The seats are 36 ins. long; width of aisle, 20 ins.; height of platform steps, 16⅜ ins., and height of risers, 13 ins. The trucks are Brill 27-G, equipped with 40-hp motors. The wheel base is 4 ft., and wheel diameter, 33 ins.

The railway company has only recently commenced operation, having constructed 6 miles of lines between Fort Worth, Marine and Rosen Heights. The new cars will doubtless prove as successful as elsewhere in the States, and by the comfort and


FORT WORTH CONVERTIBLE CAR, CLOSED

protection which they afford at all seasons of the year, will attract traffic and help to build up business in this field, which is an excellent one for electrical operation.

## FUSES FOR LIGHTING CIRCUITS

The cartridge fuses, uninterchangeable safety fuses EPI for currents up to 10 amps. at 250 volts and 6 amps. at 500 volts, made by Siemens Brothers & Company, Limited, London, have been designed with the view of placing on the market a small, cheap fuse so constructed that it is mechanically impossible to replace a cartridge, carelessly or by mistake, by one intended for a larger current, and that, with the maximum voltage admissible, no permanent arc can be maintained even with a dead short-circuit. This has been partly accomplished by providing a universal base of the smallest possible dimensions, suitable for any size of fuse, and a small and simple form of cartridge, of which only a small portion requires to be replaced after fusing, its cap remaining intact. The combination of cartridge and cap closely resembles the well-known Edison plug, but the poles are further apart and it has stronger walls and protected soldered joints. The fuse bridges of the PI cartridges consist of silver wire, placed in the interior of the body of the cartridge which is completely enclosed.

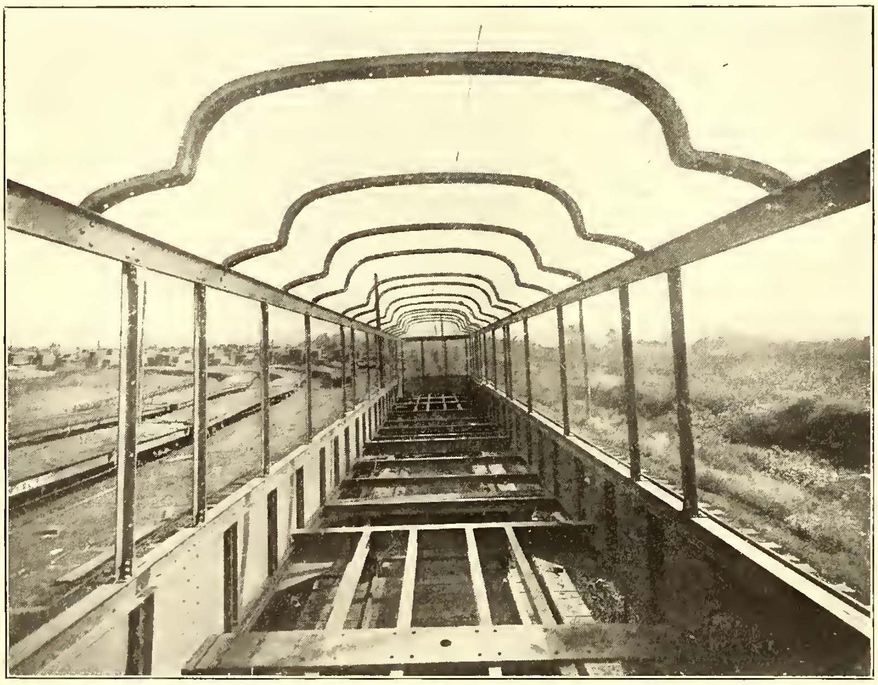
The uninterchangeability of fuses from 0.5 amp. to 10 amps., has been effected by making the lower contacts of the cartridges in the form of a round pin, the diameter of which is different for different currents, and by providing the bases with gage rings which fit the pins. Rings are not required for the 10-amp. cartridges, as this is the largest size. The contact pins and rings are both of metal and fit each other with very little play.

The PI cartridges have also been so designed that the rings for the 250-volt cartridges cannot be used in the 500-volt fuses. This is effected by providing the 500-volt cartridges with stepped pins, and rings with raised rims which do not fit the pins of the 250-volt cartridges even sufficiently to make a temporary contact. The importance of this point has not hitherto received sufficient attention, though the insertion of a low-voltage fuse in a high-voltage circuit might not only cause a drop in potential on the system, but also be the means of a fire. The rings are very easily inserted in the bases and their feet bent over, if required, at the back to prevent unauthorized removal.

The system comprises two main types of fuses, each consisting of porcelain base, connection contacts fixed in recesses in the bases, insulating cover, and cartridge with ring and cap. All metal parts carrying currents are carefully covered. The cartridges if held by their porcelain caps can be inserted without danger when the current is on. Even with a sudden absolute short-circuit at the highest working pressure a permanent arc is not formed, the melting of the fuse taking place without damage to the cartridge. The fuse can take a permanent overload of 25 per cent, and if the normal working current is doubled will melt in two minutes.

## AN ALL-STEEL CAR FRAMING

Some decided innovations which bid fair to mark a new era in the construction of electric cars for high-speed interurban service have been embodied in the all-steel framing of the private car now being built by the St. Louis Car Company for H. E. Huntington, president of the Pacific Electric Railway Company, of Los Angeles, Cal.



VIEW SHOWING FLOOR AND SIDE FRAMING AND ROOF CARLINES

Like the all-steel cars built for the subway division of the Interborough Rapid Transit Company, of New York, the car load will be carried by side plate girders. While the subway car has, in addition, two center sills running throughout its entire length, the Huntington car has none whatever, the floor being carried in the manner illustrated in the diagram of the floor framing. Another departure from the subway type is in the carlines, which consist of channels instead of angle beams.

The length of the car over the bumpers is 63 ft. 1 in. The total width is much in excess of that usually found on electric cars, being 9 ft. 6 ins., while the height from the under side of the bottom framing to the top of the roof is 9 ft. 11 ins.

The bottom framing consists of steel I-beams, riveted to the side girder plates by means of angles and gusset plates. In all, there are eleven cross sills, six of them being composed of 5-in. I-beams, and the remainder of 9-in. I-beams. The bolsters are made of 12-in. x 1-in. plates, reinforced by cast-steel fillers.

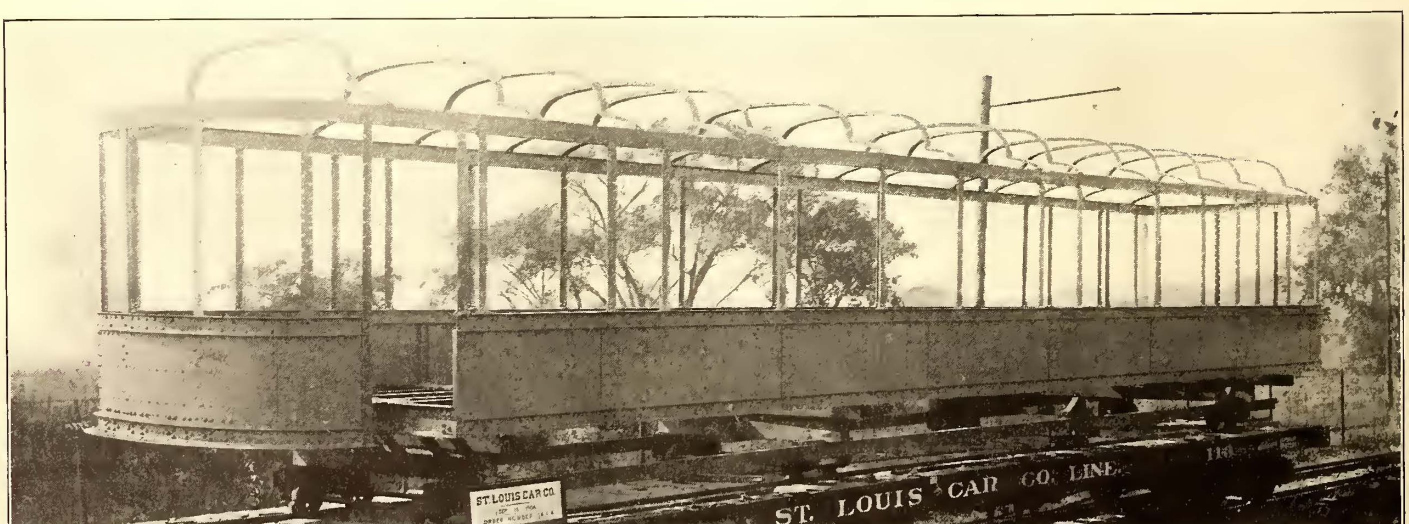
Four intermediate 4-in. I-beams extend from the first cross sills back of the bolsters to the ends of the car. In addition to these, the ends of the car are supported by four 4-in. I-beams, extending from the end sills to the end of the car.

A plate girder 36 ins. wide x 1/4 in. thick extends the full length of the car body between the belt rail and the under side of the side sill. It is stiffened at the top and bottom by channel bars placed both on the inside and on the outside of the plate.

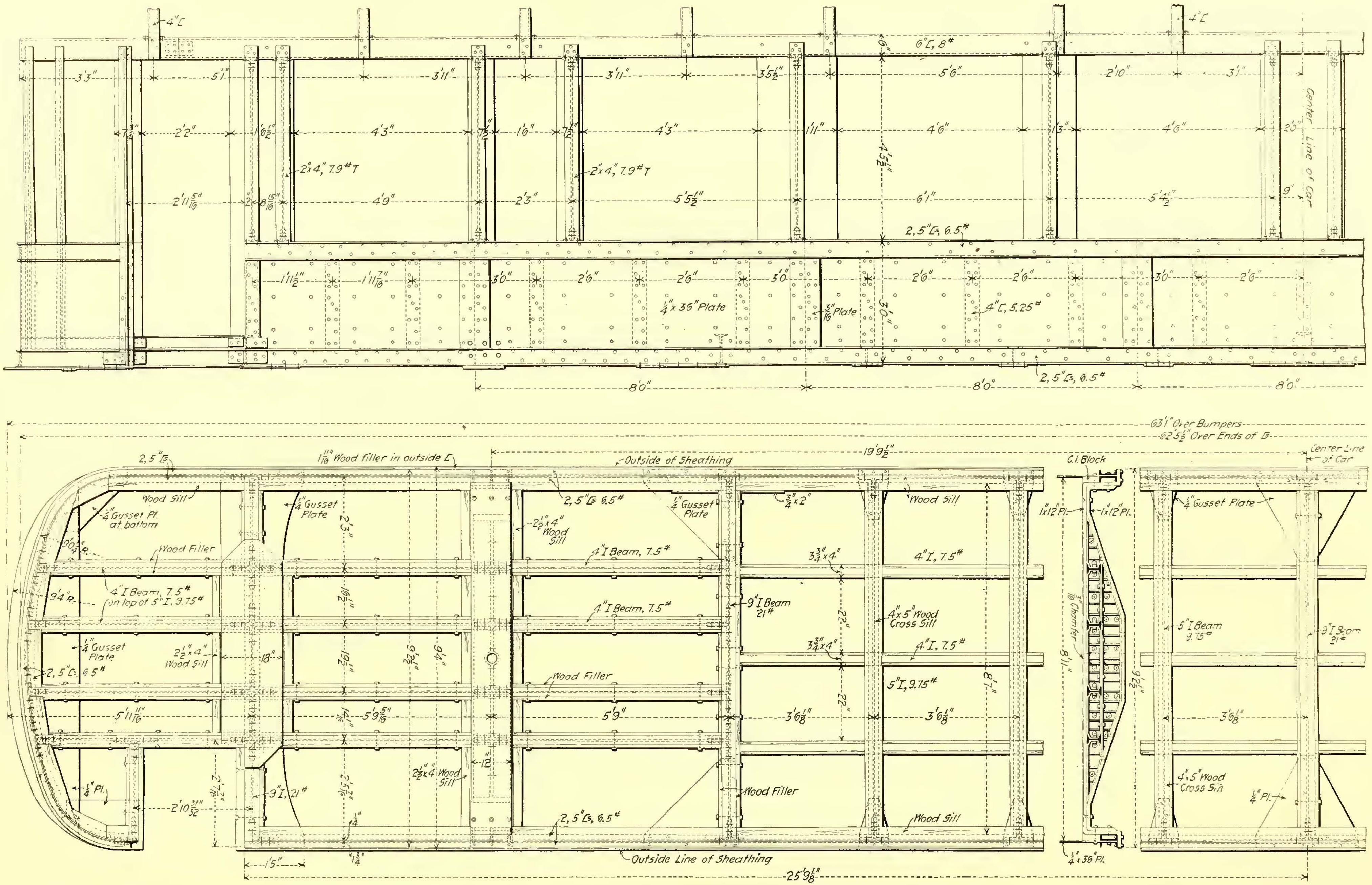
The side posts are made of T-bars, riveted to the top of the girder plate and extending to the steel channel sill.

The roof carlines are constructed of continuous steel channel bars, made of one piece, bent to suit the shape of the roof. The feet are riveted to the steel channel sills, which are made continuous, extending completely around the car. Holes are drilled at proper intervals in the girder plates, carlines and other parts. By means of these, wood fillers will be bolted for the attachment of the inside and outside finish.

The Joliet, Plainfield & Aurora Railroad Company has been completed to Aurora and an hourly service has been commenced between the two cities. The company has purchased from the American Car Company the exhibition car "Louisiana," which attracted so much attention at the Transportation Building at the World's Fair, and it will be put in service as soon as it can be removed from the Exhibition Grounds under the rules of the Exhibition Company.




ALL-STEEL FRAMING, SHOWING THE PLATE GIRDER CONSTRUCTION




PLAN AND SIDE ELEVATION OF THE NEW ALL-STEEL CAR FRAMING FOR PRIVATE CAR BUILDING FOR H. E. HUNTINGTON, PRESIDENT OF THE PACIFIC ELECTRIC RAILWAY COMPANY, LOS ANGELES, CAL.

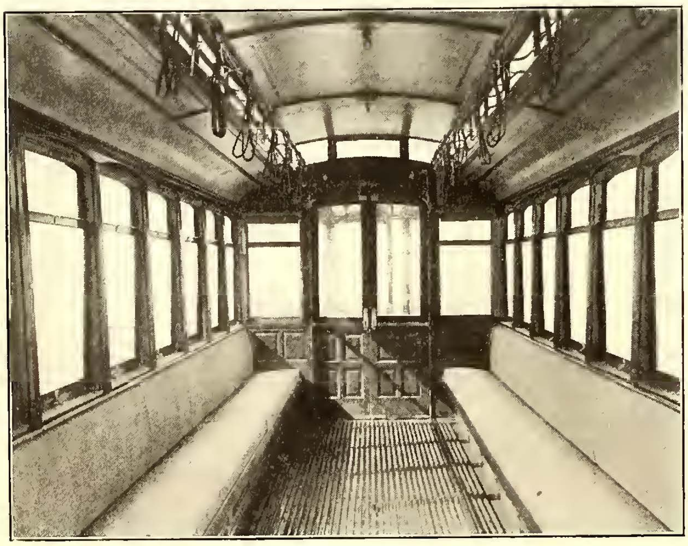
## NEW CARS FOR WASHINGTON, D. C.

The accompanying illustrations show one of a lot of twenty-five cars lately delivered to the Washington Electric Railway Company, of Washington, D. C., by the G. C. Kuhlman Car Company. These cars are for service on the Anacostia & Potomac River division, which extends out of the eastern part of

VESTIBULED CARS FOR THE WASHINGTON ELECTRIC RAILWAY COMPANY

the city and across the eastern branch of the Potomac, and has about 30 miles of track. The total trackage operated by the company in and around Washington is nearly 150 miles, with nearly 700 cars all told.

The cars measure 25 ft. 6 ins. over the bodies and 35 ft. 1 in. over the vestibules. The width over the sills is 7 ft. 10 ins., and over the posts at the belt, 8 ft. 4 ins. The sweep of the posts is 1½ ins. The side sills are 4½ ins. x 6¾ ins., with 6⅝-



INTERIOR OF CAR FOR WASHINGTON, D. C.

in. sill plates on the outside. The end sills are 4¾ ins. x 7¾ ins. The thickness of the corner posts is 4⅜ ins., and of the side posts, 2¼ ins. The interior finish is cherry, with headlinings of curly white maple. Other details are shown in the illustrations and make further description unnecessary.

## THE WORLD'S FAIR EXHIBIT OF THE MORE-JONES BRASS & METAL COMPANY

The More-Jones Brass & Metal Company, of St. Louis, Mo., has a fine exhibit of journal bearings, bronze castings, babbitt metals, solders, pig tin, ingot copper and other bearing metals in the western portion of the Transportation Building. The space is surrounded by a neat brass railing, which harmonizes well with the metals exhibited. Among the exhibits is shown "Armature" babbitt, which is specially adapted for street railway purposes. This brand of metal, it is said, contains no lead, and for it several points of superiority over other metals are claimed. The phrase, "Rings like a bell and wears like steel" has been applied to it by the company.

Various other bearing metals with tin and lead bases and several kinds of solder are exhibited. The "Arctic" journal bearings, which are made by a special process of casting, described in the Oct. 29 issue, are also shown, including bearings for steam railroad work, as well as for electric interurban and city cars. The inner structure of the "Arctic" metal is well shown by several broken sections of bearings. Those cast by the ordinary methods are also shown in sections, enabling the structure of the two to be compared. Ingot metals, pig tin and ingot copper are shown in pyramid form. The wall to the rear of the space is utilized in a unique manner. Here, upon a red background, are several ornamental figures and designs constructed of bars of solder, babbitt and other metals.

## THE AMERICAN FROG & SWITCH COMPANY AT THE ST. LOUIS EXPOSITION

The exhibit of the American Frog & Switch Company, of Hamilton, Ohio, covers a space of 1000 sq. ft. between posts 13 and 14 in aisle "C" of the Transportation Building. In this exhibit are shown three different styles of split switches—namely, the company's light rail split switch, its standard non-reinforced, and its latest design of reinforced split switches with adjustable head bars. The company also displays two styles of spring frogs, its standard design No. 1, and also design No. 18, the latter being the recently designed spring frog, changing

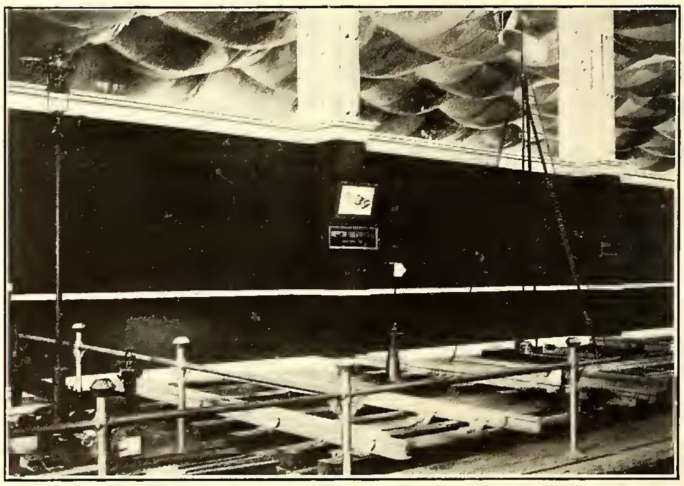


EXHIBIT OF THE AMERICAN FROG & SWITCH COMPANY

from a hinged wing rail reinforced by an outer rail. Three types of rigid frogs used for interurban and suburban railway work are also shown, as well as six different types of switch stands, ranging from the company's plain ground throw to the high ladder and target stand. All of this work is of the type the American Frog & Switch Company makes for electric railways.

The Cleveland-Toledo limited cars of the Lake Shore Electric Railway have proved so popular with the traveling public that the company has instituted two limiteds each way between Cleveland and Sandusky. They make the 60 miles in two and a half hours, stopping only in towns where there are ticket offices. This arrangement gives Lorain, Vermillion and Ceylon six limiteds each way, in addition to the regular hourly local cars, making splendid service for these towns. The running time of the local Cleveland-Sandusky cars, which run on hourly headway as heretofore, is three hours and twenty minutes.

## AWARDS AT THE ST. LOUIS EXPOSITION

Brief mention of the few awards at the St. Louis Exposition have appeared in recent issues of this paper, and an unofficial list of the Department of Machinery was printed in the last number. The accompanying list has been prepared from information at present available of the awards to those companies which are particularly in the electric railway field. As this list has been compiled from unofficial sources, there may be some additions to it.

The McGraw Publishing Company, of New York, was awarded a gold medal, the highest medal given in the Electricity Building, for technical publications. This award was based on the exhibit of the five publications of the company, viz.: The Street Railway Journal, the Electrical World and Engineer, the Engineering Record, the American Electrician and Electrochemical Industry; also upon its exhibit of technical books.

The Hooven, Owens, Rentschler Company, of Hamilton, Ohio, has received a gold medal for the 2500-hp vertical engine that it exhibited there. This engine was described in the Street Railway Journal for June 18, 1904.

The General Electric Company has received the following awards at the Louisiana Purchase Exposition: Grand prizes—1. Curtis steam turbine; 2. alternating-current turbo generator installation, alternating-current generator and motors, static transformers and rotary converters; 3. direct-current generators and motors; 4. electric railway motors and the control systems for single and multiple unit operation and for mining and industrial locomotives; 5. arc and incandescent lamp and arc lighting. Gold medals—1. complete switchboard and controlling apparatus and application of electric motors for mechanical purposes; 2. mercury arc rectifier; 3. wires and cables for light and power; 4. electric measuring instruments; 5. electric laboratory apparatus; 6. warship turret handling and controlling apparatus; 7. sewing machine motors; 8. best exhibit in electrical department, only medal awarded for best and most complete exhibit; 9. mining locomotives; 10. social betterment of employees. Silver medals—1. Sockets, switches and wiring appliances; 2. balance light distributing concentric diffuser steel ceiling; 3. electric searchlights; 4. sockets, switches and wiring appliances; 5. Lemp irreversible automobile steering check. Bronze medals—1. Lumichromoscope; 2. porcelain wares.

The Galena-Signal Oil Company, of Franklin, Pa., has been awarded a grand prize for railway lubricants and railway signal oils.

The R. Thomas & Sons Company will receive a gold medal for its exhibit of high-voltage insulators.

The Consolidated Car-Heating Company has been awarded a gold medal for heating apparatus at the St. Louis Exposition.

The Harrison Safety Boiler Works, of Philadelphia, Pa., has been awarded several gold medals. They further understand that the Cochrane feed-water heaters and the Cochrane steam oil separators were the only heaters and separators for which gold medals were awarded.

The Gould Storage Battery Company, of Depew, N. Y., has received a gold medal for its battery, and a silver medal for its booster system, the highest awards in both cases.

The John Stephenson Company, of Elizabeth, N. J., has received a silver medal.

The Leonhardt Wagon Manufacturing Company, of Baltimore, Md., has been awarded a bronze medal at the World's Fair for its tower wagon. The demand for this wagon is constantly increasing.

The St. Louis Car Company, of St. Louis, was awarded the grand prize for excellency in the manufacture of cars, trucks, seats, headlight, vertical wheel brakes (patented), and brass car trimmings, gray and malleable iron castings, and its other specialties.

The Standard Steel Car Company, of Pittsburg, Pa., has received an award of a silver medal for its electric motor truck exhibit. The judges stated that they were unable to give a higher award, owing to the fact that the trucks did not arrive at the exposition until Oct. 7, and also to the fact that they had been in service but a few months.

The Brown Hoisting Machinery Company, of Cleveland, Ohio, has been awarded the grand prize, in class 64, for its Brownhoist locomotive cranes, in its exhibit in the Machinery Building.

The Heine Safety Boiler Company, of St. Louis, Mo., has been awarded a gold medal for its exhibit of boilers in the Steam, Gas and Fuel Building in the Louisiana Purchase Exposition, and a gold medal also for its exhibit in the fuel testing plant of the United States Geological Survey.

The Allis-Chalmers Company, as already announced, was given three grand prizes; viz., one for its steam engines, one for electrical machinery, and one for its mining machinery; also a gold medal for the Bullock method of operating variable-speed motors for driving machinery.

The McGuire-Cummings Manufacturing Company, of Chicago, Ill., has received the silver medal on electric trucks, snow sweepers and pneumatic street sprinklers. This is the highest medal that could be given it on this exhibit, as the company states that there was no competition by other exhibitors on trucks, sweepers and sprinklers.

The Alberger Condenser Company, of New York, has received the highest award, a grand prize, for its exhibit of condensing apparatus. This apparatus was described in the Street Railway Journal of May 7.

William T. Bonner & Company, of Boston, Mass., have been awarded a gold medal by the superior jury for their line of gages and mountings, exhibited at the Universal Exposition.

The American Brake-Shoe & Foundry Company, of Mahwah, N. J., has been unofficially informed of the award of a gold medal for its exhibit.

The Buckeye Engine Company, of Salem, Ohio, had on exhibit at the St. Louis Exposition a 26½-in. x 50-in. x 48-in. heavy duty cross-compound condensing engine, for which it has received a gold medal, the highest award in its class.

The Weston Electrical Instrument Company, of Newark, N. J., has received notice of the award of two grand prizes.

The E. W. Bliss Company has been awarded the grand prize and the gold medal for tools and machines exhibited at the Louisiana Purchase Exposition at St. Louis. The awards were granted for superiority of workmanship, smoothness of action, ingenuity displayed in design and highest quality of product.

The Pantasote Company, of New York, has received the grand prize and two gold medals for various sections of its exhibits.

The Walworth Manufacturing Company, of Boston, Mass, has been awarded a gold medal for brass and iron valves, and also for its display of tools, including the Stillson wrench, Walworth die plate, Miller ratchet, etc.

The Niles-Bement-Pond Company, of New York, and the Pratt & Whitney Company have been awarded the following prizes: Niles-Bement-Pond Company, grand prize, group 65; Pratt & Whitney Company, grand prize, group 65; Pratt & Whitney Company, gold medal, group 66.

A grand prize has been awarded by the Louisiana Purchase Exhibition to the Laidlaw-Dunn-Gordon Company, of Cincinnati, which installed the two large compressors located in Block 33, of Machinery Building, for improvements in the valve mechanism of air compressors.

The Continuous Rail Joint Company of America, Newark, N. J., has received from the Jury of Awards of the Louisiana Purchase Exhibition, the gold medal for rail fastenings, for its display made in the Transportation Building of its rail joint products. The company's exhibit of various types of rail joints was referred to in the Street Railway Journal of June 11, together with an illustration of a new bond recently designed by the company.

The Hale & Kilburn Manufacturing Company, of Philadelphia, Pa., has been awarded a gold medal. The ample dimensions and the extended display of this company in the Transportation Building adjoining the convention meeting rooms attracted wide attention. The novelty of automatic moving car seats placed on top of a very beautiful screen in the rear of the exhibit, was admired by many thousands of visitors. The varied character of the display in styles of seats, covering materials, as well as finishes of woods, adds brightness to the exhibit, and together with the beautiful color scheme of the posts, columns, etc., unites in making this one of the handsomest exhibits ever made at this or preceding street railway conventions. Several new electric car seats are shown, and the high standard of merit found in the Hale & Kilburn products, has been combined with novelty in these new seats, in which the highest points of superiority are developed. This display was described in the Street Railway Journal of June 18.

The Goldschmidt Thermit Company, of New York, has been awarded the grand prize at the St. Louis Exposition. The company is highly pleased with this recognition of Dr. Goldschmidt's invention, as it went to considerable trouble and expense in making its exhibit at the World's Fair as complete as possible.

The Sherwin-Williams Company, paint and varnish makers, of Cleveland, Ohio, has no special exhibit at St. Louis, but has been informed by the American Institute of Social Service that it has been given a gold medal for its work in social betterment movements.

The J. G. Brill Company, Philadelphia, Pa., has received a gold medal at the St. Louis Exposition on the following: Full convertible car, semi-convertible car, Narragansett car, No. 27-E-3 truck, No. 27-E-2 truck, No. 27-E-1 truck, No. 21-E truck, No. 22 maximum traction trucks, No. 27-G trucks; and also a gold medal on its forged frames. This company's exhibit, of which a description was published in the STREET RAILWAY JOURNAL of June 11, was characterized by a choice selection of representative Brill cars and trucks, rather than by any attempt to make an elaborate display. The high honors accorded to the company speak well for the merit of its products.

The Atlas Railway Supply Company, of Chicago, Ill., has received a bronze medal.

The Truscott Boat Manufacturing Company, of St. Joseph, Mich., was awarded the grand prize, said to be the first that has ever been given to any company manufacturing small launches and their power equipment at any exposition.

The St. Louis Car Company has been awarded the Grand Prize for the excellency of its products, which were exhibited in the Transportation Building, and comprised cars, trucks, seats, headlights, interior arc lights, vertical hand-wheel brakes, bronze car trimmings, gray iron castings and malleable iron castings.

The Westinghouse Companies have received twelve grand prizes and a large number of other awards, in addition to a special award in the Department of Machinery for "the best, most complete and most attractive installation." A detailed list of all the awards granted to these companies was published in the STREET RAILWAY JOURNAL of October 29. It might be noted, however, that three grand prizes were awarded to the Westinghouse Electric & Manufacturing Company, one grand prize each to the Westinghouse Machine Company, Westinghouse Traction Brake Company, the American Brake Company, and the Westinghouse Automatic Air & Coupler Company, the Union Switch & Signal Company, and the Cooper Hewitt Electric Company; also to the Westinghouse Brake Company, Ltd., of London, England, and the Westinghouse Company, Ltd., of St. Petersburg, Russia.

## LONDON LETTER

[*From Our Regular Correspondent.*]

The Municipal Tramways Association held its meeting this year during the last week of September, in Liverpool, and almost needless to say, was entertained most cordially by the officials of the Liverpool Corporation. The meeting was held in St. George's Hall, and the proceedings were opened as usual with an able presidential address by Mr. C. R. Bellamy, who has been president of the association for the past year. The address was published in the last issue, together with an account of the technical discussion, and it only remains for us to say that it met with proper approval by the managers in the meeting, and has also found favor in the opinion of editors of the local press. The social side of the convention was most agreeable. In the evening of the first day a dinner was extended to the association by the tramways committee of Liverpool Corporation, which was a most enjoyable function. The following afternoon special cars took the delegates to visit the Lambeth Road works and the Lister Drive power station, and in the evening the delegates and their friends all met for the association dinner, which was much enjoyed by all, being of a private nature. On the day following a beautiful trip was laid out for the pleasure of the delegates, the weather being on its very best behavior. The delegates had to start by special cars at 9 o'clock in the morning, and proceeded over the Liverpool Corporation rails as far as the boundary line, at which point the cars were transferred to the rails of the South Lancaster system, and proceeded to Prescot, where a number of carriages were in attendance for a drive to Knowsley Hall, the residence of the Earl of Derby. The Hon. Arthur Stanley did the honors of the hall, and a most enjoyable time was experienced by all. The return to Liverpool was made in the same manner, and in the evening the Mersey Dock Board tender "Galatea" was in attendance for a cruise round Liverpool Bay.

Mr. John Young, who was manager for years of the Glasgow Corporation Tramways, has resigned his position and has associated himself with the management of the Underground Electric Railways in London, which are controlled by Mr. Yerkes. Since the introduction of electric traction in Great Britain there has probably been no one so much in the public eye as Mr. Young, as he was fortunate enough to be in the position of manager of the Glasgow Corporation Tramways at the time when electrification was considered, and where naturally a large and intricate system had to be installed. That the work was well done under Mr. Young's supervision is amply evidenced by the results which have been achieved, and for years past Glasgow has been the "Mecca" of all tramway committee men from other cities who have been seeking for information previous to electrification in their own cities. Mr. Young has been associated with the corporation of Glasgow since 1875, being at that time superintendent of the cleansing department. In 1892, when the corporation decided to work its own tramways, Mr. Young was appointed general manager, and has been in that position ever since, though six years ago he was offered a most important tramway appointment in London, which was finally declined by him. Mr. Young has made a phenomenal success of the Glasgow Tramways, and while the municipal tramway managers of the country will be sorry to lose him from their midst, yet everyone who knows him will join with us in expressing our congratulations on his appointment to such an important administrative position, where his great organizing talents will be called into the very fullest request and where under Mr. Yerkes he will get another opportunity to enhance his present high reputation.

In the meantime, Mr. Dalyrmple, who has for some little time been acting as deputy manager of the Glasgow Corporation Tramways, in addition to his own work as Corporation Tramways accountant, has been first appointed interim manager, and has now been formally appointed to the full duty as manager. There could hardly be a better selection for the management of the Glasgow tramways, as Mr. Dalyrmple has been associated with them for the past ten years, where he has done magnificent service as accountant. Mr. Dalyrmple joined the service of the corporation of Glasgow over twenty-three years ago, and, after serving in several departments, was appointed accountant to the tramways when the city took over the system in 1894. About three years ago he was appointed deputy general manager. In his position as accountant and as deputy manager he has become thoroughly familiar with all the details of the manager's position, and the tramway committee is to be congratulated upon being able to find so suitable a man at hand to fill the vacancy without having to advertise in the usual way, and whereby a stranger would probably have had to be introduced to the position.

The construction of the permanent way for the Birmingham Corporation Tramways may be fairly stated to break all records for high-speed work. It was an essential condition of the contract that the system should be completed in a short space of time, and when one remembers that the line traverses the center of the city, where the traffic is unusually heavy, it was highly important that interference to the streets should be reduced to a minimum. The contractors were set no easy problem, however, for, in addition to completing the work quickly, they had to preserve a portion of the road intact not only for ordinary vehicular traffic, but also a complete tramway line over which the steam cars could continue a service. How dense was the tramway traffic alone may be gaged from the fact that on occasions no fewer than 1000 cars per day have been known to pass a given spot. Notwithstanding the many difficulties, however, Dick, Kerr & Company have actually completed the work, comprising 9820 lineal yards single track and eleven junctions, with 20,000 sq. yds. of new paving outside the tramways, in twelve weeks. In order to secure this, the work for several weeks was completed at the rate of over 2300 yds per week, a performance which is unparalleled in tramway construction, having regard to the exceptional difficulties met with in maintaining and executing same and working on crowded thoroughfares. This firm had previously completed contracts with remarkable celerity, but it is likely that on this occasion they have broken their own records.

The second annual report of the Underground Electric Railways Company, of London, which is a company organized some time ago by Mr. Yerkes to operate the Metropolitan District Railway, the Great Northern Piccadilly and Brompton tube, the Baker Street and Waterloo tube, and the Charing-Cross, Euston and Hampstead tube, has just been submitted. It states that the large power house at Chelsea is rapidly approaching completion, and it is proposed to take authority to raise £850,000 on the security of the power house. Three-quarters of the machinery have already been delivered, including two of the large turbo-generators from the British Westinghouse Company, and the switchboards have been all in working order for some time. The Babcock & Wilcox boilers are also in their places, and the ducts and cables forming the transmission line were complete some time ago. The work of the conversion of the Metropolitan District Railway from steam to electricity has proceeded most satisfactorily. All the cable ducts have been laid, the brackets and troughs for the cables are in their places and most of the conductor rails have been laid and bonded. The sub-stations are also well advanced, and it is expected that this railway will be operated by electricity early in 1905. The tube railways above enumerated are also proceeding satisfactorily, and might be said to be about three-quarters finished. An important change in the Metropolitan District Railway is progressing favorably in replacing the station platforms, which are at present of wood, by concrete, and this change is being effected without disturbing the traffic. The accounts show that the outlay on lands and works during the year has been £3,213,300, raising the total to £5,848,900.

Dr. Sylvanus P. Thompson has been writing recently to the

"Times" in condemnation of the live rail, generally known as the third rail, which he maintains is an obsolete engineering device and a blunder which should never have been committed. It will be remembered that Dr. Thompson would have been pleased to see the three-phase overhead system adopted in the electrification of the Metropolitan Railway and Metropolitan District Railway, and his present attitude is now undoubtedly induced by the experiments which are being conducted on the single-phase system both in America and on the Continent. It would appear somewhat anomalous for Dr. Thompson to take up such a position at the present when it is well known that electrical engineers of greater experience in tramway and electric railway construction have been experimenting in this direction for years, and it would hardly appear just to the magnificent work that has been done in the last ten years to condemn so universally the third-rail system, which has undoubtedly filled the wants of electrical engineers for years past when no other system was available. If the third-rail system had been so blindly condemned years ago the present work of electrification would have been at a standstill. As the editorial columns of this paper recently said, it has never been conceived that the third rail would fulfill every condition, but electrical engineers have had to use what systems have been available.

After months of discussion, the South Shields Town Council has at last decided to municipalize its tramways, and will not enter into arrangements for any company to operate them. The whole scheme will involve an expenditure of about £153,000. The present trams and 'busses carry something like 3,000,000 passengers every year, and the gross revenue is about £12,400.

Upon the question of electrification of the tramways in the East End of London, the Borough Engineer of Stepney has recently reported that the reconstruction and electrical equipment is within measurable distance of realization. The London County Council has not insisted upon a uniform system for the district, but rather recommends a combination of the conduit and overhead trolley systems. In High Street, Whitechapel, Commercial Road, East India Dock Road, Whitechapel Road, Commercial Street and Leman Street it is proposed to install the conduit system, while in other streets it is proposed to have the overhead trolley system. The Stepney Borough Council, however, despite the admitted cheapness of the latter system, is entirely opposed to it on the ground that it is only suited for those districts removed from crowded centers. The local authorities, in their opposition, rely upon the London County Council Tramways' electrical power act, which does not authorize the Council to place in any parish or district any poles or wires on or over any street for working tramways by electrical power unless the Parish Vestry or Board of Works for such district shall have consented to the adoption of such a system.

In the northern section of the city the same question is also being deliberated. The Clerk to the London County Council has written to the St. Pancreas Council on the subject of its requirement that one system of electrification of tramways—the underground-conduit system—should be adopted throughout the borough. He points out that the County Council has endeavored to arrange for the conduit system in the more central districts, overhead traction being as far as possible confined to the outlying areas. He adds that it is estimated that the additional outlay which would be involved by the substitution of the conduit system on those routes for which it is suggested that the overhead system should be employed would amount to something like £500,000. A special committee of the St. Pancreas Council recommend the Council to adhere to its resolution requiring adoption of the conduit system throughout.

The half-yearly meeting of the shareholders in the Mersey Railway Company was held in the company's offices, London, recently. Mr. James Falconer, chairman of directors, presiding. In moving the adoption of the reports and accounts, the chairman stated that the number of passengers carried, exclusive of season ticket holders, during the half year was about 4,500,000, as against 3,200,000 during the corresponding half year in 1903, an increase of something like 40 per cent. The receipts from those passengers, including season ticket holders, had increased from £26,136 to £33,715, equal to 29 per cent. There was a very substantial increase in the number of persons traveling under season tickets, as was shown by the fact that the receipts from season tickets advanced from £3,485 to £4,167, or 20 per cent. From all sources the total increase in the receipts was from £32,278 to £40,918, or about 25 per cent. The total working expenses were £33,591, as against £32,061, an increase of £1,530, but that included the exceptional charges for pumping and ventilation. If they excluded those charges the working expenses were £29,751, as against £27,375, an increase of £2,376. During the past half year the train mileage was 411,683, as against 218,308 in the corresponding period of 1903, so they had been running something like double the train mileage, and consequently doubling the convenience and facilities for traveling for the public. If they excluded the exceptional charges of pumping and ventilation, the cost per train-mileage in the corresponding half year of 1903 was 30.1d, or practically 30d, per train-mile. That was for four months of steam and two months of electricity. During the past half year the cost per train-mile of the electrical service was 17.35d, equal to a 40 per cent reduction. If, however, they included the exceptional charges for pumping and ventilation, the cost per train-mile for the half year in 1903 was 35.25d, while the cost during the past half year was 19.58d, practically a reduction of 16d upon 35d. That was a very striking result of the change from steam to electricity. These figures conclusively established the extraordinary superiority of electrical traction over steam traction in dealing with such a railway as this. If he wanted to put briefly and simply the position and prospects of the Mersey Railway, he would say they had now demonstrated that at a cost of 19½d per train-mile they could carry double the number of passengers they were carrying at present. They had reached a point of earning per train-mile from all sources something like 2s, and the whole future of the company depended upon their increasing that figure of 2s per train-mile.

Mr. Arthur Ellis, Cardiff, borough electrical engineer and manager, has issued his report on the working of the tramways for the year ending March last. The total income from all sources is set down at £108,442, and the working expenses at £69,478, leaving a gross profit of £39,964. The actual net surplus balance was £7,724. There was a total disposable balance of £14,976, in addition to £5,796 allocated to a loans fund suspense account, and these amounts represented the excess income over expenditure since the inception of the system. The working expenditure per car-mile was equal to 5.818d per car-mile—a very reasonable result when compared with other towns. The ratio of working expenses to receipts worked out at just under 62 per cent. The greatest burden arose in the amount required to be paid out of revenue for loan charges, which alone absorbed 3.053d per car-mile, the capital at the end of March amounting to £687,222. The receipts from fares alone total £101,794.

The electric tramway system inaugurated by the Swindon Corporation was publicly opened recently. The 3½ miles of route have been equipped with the overhead system, and seven cars have been obtained at a cost of about £38,000, but other 3 miles of route have been sanctioned, while it is tolerably certain that three or four more cars will be required. A dinner was given to the employees engaged in the electricity and tramways undertaking, while the Mayor entertained the members of the Corporation and other gentlemen to luncheon. Lord Edmond Fitzmaurice, M. P., proposed "Success to the Swindon Corporation Tramways," and expressed the opinion that the venture would be an increased source of prosperity to the town and convenience to the inhabitants.

With the object of providing a special inducement to the Halifax Corporation to bring trams into the Sowerby district, the Sowerby Council a month ago decided that, so far as it legally could, it would indemnify the Halifax Corporation from the payment of rates on such tramways for a period of five years. This has called forth an interesting communication, which clearly indicates the attitude of the railway companies in such a case. The letter is from Mr. Skelmerdine, of the Rates and Taxes Department of the Lancashire & Yorkshire Railway Company, Manchester, who, on behalf of the company, opposes the adoption of any such resolution, as being both illegal and contrary to the provisions of the public health act. He adds: "It is perfectly clear that for the District Council to say they will not rate property for district rate purposes is giving unfair preference, and one which the railway company, as one of the largest—if not the largest—ratepayers in the district must strongly protest against." A copy of this letter has been forwarded to the Halifax Corporation. A. C. S.

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The Columbus, Delaware & Marion Railway Company has been incorporated with $2,500,000 capital stock for the purpose of taking over the Columbus, Delaware & Marion Electric Railroad Company, capitalized at $1,600,000, and operating an interurban road from Columbus to Marion; the Marion Railway, Light & Power Company, capitalized at $500,000, operating an electric railway system and lighting plant at Marion, and the Columbus Northern Railway, Power & Equipment Company, which was incorporated a short time ago for the purpose of erecting a large power station with which to operate the railway system. The companies mentioned are controlled by the same interests. The following officers have been elected: John G. Webb, Oscar Gottschall, M. G. Catrow, Dayton; H. B. Hanes, of Marion, and E. M. Campbell, of Indianapolis, directors. John G. Webb was elected president; M. J. Catrow, treasurer; W. A. Black, secretary; George Whysall, general manager. A branch line will be built to Richwood and additional rolling stock will be purchased. The power house will be located north of Delaware.

## PARIS LETTER

*(From Our Regular Correspondent.)*

The new line (No. 3) of the Paris-Metropolitan Railway has at last been placed into partial service. The line, details of which have been given from time to time, has a length of 5 miles, including terminal loops, and has a rather difficult profile in comparison to the two lines already in service. The equipments include the well-known type M control, with automatic or hand acceleration at the will of the driver. The motors, of which there are six per train, are of about 175-hp rating and the trains comprise five double-truck cars, 14.50 m in length, of which the first, third and fifth are motor cars. The trains have a holding capacity of over 600 passengers, about one-half of these being able to find seats. Service has not been opened over all the line, certain of the stations not being completed, and the trains accordingly do not stop thereat. The equipments for this new line have been supplied by the French Thomson-Houston Company.

On line No. 2 (northern portion) there have recently been placed in service some sixty new double-truck cars, with a seating capacity of seventy-four passengers, and standing room for another forty-five. These cars have been fitted with the Westinghouse pneumatic control of the latest type. Some interesting experimental comparisons are expected to be made on these lines between the two types of equipments.

The appearance of motor-omnibuses in London has roused a certain interest here. The General Omnibus Company, of Paris, whose concession will expire in a very short number of years, is to a certain extent tied to the horse-omnibus. Nevertheless, some experiments with a motor-omnibus have been carried out, the type being a Serpollet, similar to the steam tramways now in service, but the fuel being petroleum. It is, however, doubtful whether the expense of introducing a new type of bus will be justified by the financial position of the Omnibus Company.

Propositions have recently been laid before the Italian Government regarding a new and shorter route through the Alps between Turin and the Central European cities, via Martigny. This will add a fourth route to the already existing Mont Cenis, St. Gothard, and the nearly complete Simplon routes, and it is interesting to note that the distance to be covered between Turin-Paris will thereby be shortened by 50 km, Turin-Bâle by 62 km, Genoa-Lausanne by 75 km, Turin-Lausanne by 143 km, Savonne-Lausanne by 79 km, and Nice-Genoa-Lausanne by 240 km. This project, if realized, will be sure to ameliorate in a very sensible fashion the existing relations between northern Italy and the principal European centers, and it is believed that the Indian mail to Brindisi from London, will choose the route in preference to all others.

The length of the proposed line is 157 km, and the maximum grades are 5 per cent. The line will be situated entirely among mountain ranges and electric traction will be provided from the numerous water-falls in the region. Starting from the main line which united Modane on the French frontier to Turin, the new line will cross the Canavais plains to Pont, where it will enter the valley of Rouco, and, by means of a gallery, hollowed under the well-known Grand Paradis range, it will touch the village of Cogne, thence mounting the left side of the Aosta Valley, it will pass Morgex, St. Didier and Courmayeur. From this place, by a tunnel through the Col Ferret, the line continues in Swiss territory to Martigny.

The project is associated with the name of Radcliff Ward, who has given serious attention to the scheme. The Piedmont district is strongly in favor of the scheme and a financial syndicate has been formed to support the project now before the Italian Government.

## C., P. & A. RECEIVER DISCHARGED

A. B. Cleveland, who, as receiver, has been in charge of the affairs of the Cleveland, Painesville & Ashtabula Railway for the last ten days, has been discharged by the courts, and the road has reverted to the management of J. R. Curtiss, general superintendent of the company. Mr. Cleveland was appointed receiver of the company at the request of J. D. Mitchell who, as previously noted in the STREET RAILWAY JOURNAL, asserted that the road was insolvent and was mismanaged, and that to protect his interest a receiver should be appointed. The statement is made that Mr. Mitchell was unable to prove that the road was insolvent, and that he went into court again and acknowledged that the claims did not rest upon a basis which would find standing in court, and asked that the receiver be discharged. This action was taken before the directors of the company had an opportunity to apply to the court for the discharge of the receiver.

## TRIAL OF NEW YORK CENTRAL LOCOMOTIVE

A test was made at Schenectady, N. Y., on Friday, October 28, of the first of the electric locomotives now building by the General Electric and the Baldwin Companies, for the New York Central Company's terminal service in New York. Prominent officials of all of these companies were present, and general satisfaction was expressed with the result. At 11:25 a. m. the start was made over the General Electric Company's experimental line to Hoffman. In the cab of the locomotive were W. K. Vanderbilt, W. J. Wilgus, E. B. Katte, P. P. Spalding, of the New York Central; Hinsdill Parsons, president of the Schenectady Railway Company; W. B. Potter, A. F. Batchelor, of the General Electric Company, and Frederick F. Eisenmenger, Mayor of Schenectady. A speed of about 55 miles an hour was attained, but no attempt was made at fast driving. An unfortunate incident of the test was the injury of W. B. Potter, who, while leaning out of the cab was struck on the head by a pole. Among those present were:

William B. Potter, chief engineer of the railway department, General Electric Company; A. F. Batchelor, E. D. Priest and P. P. Spalding, of the General Electric Company, who were directly in charge of the test; Fifth Vice-President W. J. Wilgus, of the New York Central; William K. Vanderbilt, Jr., of the New York Central; Edwin B. Katte, electric engineer of the New York Central; M. F. Westover, secretary of the General Electric Company; Hinsdill Parsons, George de B. Greene, A. H. Armstrong, G. H. Hill, C. E. Barry, J. W. Upp, of the General Electric Company; Edward F. Peck, general manager of the Schenectady Railway Company; Captain Frederick Smith, superintendent of the Schenectady Railway Company; Mayor Frederick F. Eisenmenger, Justice Wemple, Julien Du Bois, of the F., J. & G. Railroad Company; Bion J. Arnold, a member of the New York Central electrical commission.

## LONDON UNDERGROUND ADVANCING

In his annual report to the stockholders of the London underground companies, Chairman Yerkes reviews the progress of work on the several different undertakings. The power house which will supply the Metropolitan District Railway, the Great Northern, Piccadilly & Brompton Railway, the Baker Street & Waterloo Railway and the Charing Cross, Euston & Hampstead Railway is nearing completion. Three-quarters of the machinery has been delivered, including two of the turbo-generators, which are now being erected, and it is expected that tests of the machinery will be made during November. The new rolling stock for the Metropolitan District Railway, made entirely of non-inflamable material, is expected to be delivered during November and December. Deliveries are now being made of the electrical equipment for the cars. All the surface station sites on the Charing Cross, Euston & Hampstead Railway have been acquired. About 75 per cent of the running tunnels has been driven, and the work of constructing the shafts, cross passages, etc., is well advanced. The land required for the car sheds and repair shop has been secured at Golder's Green, Hampstead, and work on the construction will shortly begin.

## TWIN CITY COMPANY WINS FRANCHISE SUIT

The decision of the United States Circuit Court, Judge Lochren presiding, in the case of the city of St. Paul against the Twin City Rapid Transit Company, is in favor of the company. The city attacked the status of the company by maintaining that the enactments by which it held its charter were unconstitutional. The decision of the court was that the charter of the company is quite sound. The suit was not brought to deprive the company of franchise rights already taken advantage of, but to ascertain whether the company could make extensions and improvements without obtaining further franchises. The city maintained that the original charters were granted for horse power only, and that electricity could not be introduced on the old lines and new lines could not be built and operated with that power. The judge overruled these contentions and took the view that while animal power was the only sort contemplated by the ordinance of 1872, the idea at that time was to prevent the introduction of a steam railroad upon the streets of the city and no more. The judge held, therefore, that electricity might be used for improvements and extensions under the old franchise, and that the company has the right to build and operate electric lines on all the streets and avenues of St. Paul except the street specifically exempted by ordinance 1227, passed in 1889, without let or hindrance by the city and without further authorization from the Common Council.

A stay of ninety days in which to prepare an appeal has been allowed, and the case will probably be carried higher.

## THE NEW YORK SUBWAY OPENED

The New York Subway was opened to the public promptly at 7 o'clock p. m. on Thursday, Oct. 27. The formal ceremonies marking the event were held earlier in the day, at 1 o'clock, in the City Hall. Gathered together at that time in the Council chamber were city officials, representatives of the operating and construction companies that had to do with the building of the subway; prominent financiers, engineers of note, and many others. It is estimated that about 600 were admitted to the chamber to witness the ceremonies. Bishop Greer offered the opening prayer, in which he invoked blessings upon the new road, protection from accidents, and the growth of moral, material and spiritual life in the city. Mayor McClellan was then introduced as presiding officer. He made a short speech, calling attention of the value of the work to the city.

Chief Engineer Parsons was next introduced. He simply stated that the subway was ready to be opened for traffic. Alexander E. Orr, president of the subway commission, who followed Mr. Parsons, said that Messrs. McDonald and Belmont were entitled to a generous reward for their courage and enterprise. After complimenting the chief engineer, saying that, while the commission chose the route, "the merit of the plan of construction and its supervision from beginning to end were Mr. Parsons's alone," Mr. Orr concluded:

"As long as this subway is made to render service to the people of New York, the Chamber of Commerce, Abram S. Hewitt, John B. McDonald, August Belmont, and William Barclay Parsons should be held in remembrance as household words.

"And now, Mr. Mayor, on behalf of the commission, I beg to give you official notice that it is our judgment the subway may be safely opened for passenger traffic from the City Hall Station to the station on the Western Division at One Hundred and Forty-Fifth Street; and further, that it is expected, in a very few weeks, the Eastern Division will be ready for operation as far as the station at Lenox Avenue and One Hundred and Forty-Fifth Street. It is too early yet to estimate when the subway will be completed to its northern terminal points, although the commission is satisfied Mr. McDonald and the Rapid Transit Subway Construction Company are doing all in their power, in the face of very adverse circumstances, toward this desirable end.

"I may also add for general information that we fully expect the portion of the Brooklyn Division, situated between the City Hall Park and the South Ferry, will be ready for operation some time during the coming summer. It is already well progressed without having seriously interfered with the street traffic of lower Broadway."

Commissioner John H. Starin's speech was a review of the commission's history and trials. He complimented the active officials in the work and recalled the struggle of 1891-2, when the elevated interests battled to prevent the building of tunnels. The inside history of that hot controversy, he declared, would never be told fully.

By this time it was 2 o'clock, and as Mr. McDonald, the contractor, responded to Mayor McClellan the din began of whistles of factories and boats on the river, accompanied by wild shrieks from the air whistles of the elevated trains, and the cheering of the great crowd in City Hall Park. All this was in accord with the Mayor's request that such demonstration be made at that hour.

Mr. McDonald graciously gave the credit for the consummation of the great work to all the interests involved, laying particular stress upon the harmony of interests that marked every proceeding. August Belmont, who financed the undertaking, was next introduced. His was the longest speech of the afternoon, and was, in the main, a brief review of the banking problem that the work involved.

The benediction, pronounced by Archbishop Farley, was very brief. When it was over the Mayor said:

"Now I, as Mayor, in the name of the people, declare the subway open."

August Belmont then walked to the chair and, while the audience cheered, handed to the Mayor a mahogany case, containing a silver controller, saying:

"I give you this controller, Mr. Mayor, with the request that you put in operation this great road, and start it on its course of success and, I hope, of safety."

At 2:19 o'clock the audience, headed by the special guests, left the City Hall for the loop station. A train was in waiting here for the Mayor and his party, which consisted of Mr. McDonald, Mr. Parsons, Mr. Belmont and most of the others who made the subway a possibility and a reality. The Mayor acted as motorman of the train. He used the silver controller handle, given to him by Mr. Belmont, and ran the train to Broadway and One Hundred and Third Street, where he yielded the place to the regular motorman, who, in this case, was the company's instructor in charge of its school for employees. Following the official train were others operated until 6:00 p. m. for the benefit of invited guests.

From 6 o'clock to 7 o'clock there was a cessation of operations, preparatory to the opening of the road to the public. As was to be expected, an immense crowd gathered at each of the stations waiting anxiously to avail themselves of a "first" ride. At no point along the route, however, was there so many people as at the City Hall station. Here the crowd overflowed into Park Row and Chambers Street. Despite the anxiety there was little or no disorder. The figures of the management show that between the time of opening and 12 o'clock some 127,380 passengers were carried without delay. The return for this period were magnanimously given by Mr. Belmont to the charitable institutions of the city.

The story of the subway since then has been one of the handling of crowds little dreamed of by the management. Of course there have at times been delays, but only such as have been excusable on account of the newness of the equipment and of the persistency of persons to use the subway who could to better advantage travel on the elevated. Then the curious and the out-of-town visitors have by their actions added materially to the burdens of the management. This was most strikingly shown on Sunday, when train schedules were interrupted by a vast throng of visitors, whose especial delight seemed to be to ride uptown and then down again. Many of these people brought their lunches, and they seemed not at all dismayed because of the fact that they were, in some cases, subjected to long and tedious delays in getting into the subway.

## AMERICAN ASSOCIATION OF STREET RAILWAY CLAIM AGENTS

This association, whose organization at St. Louis was mentioned in the issue of this paper for Oct. 15, has already secured fifty-six members, which include the companies in most of the large cities. This assures the success of the organization, and it is thought that other companies will join as soon as the benefits of the association are more fully realized.

The object of the organization is to assist the different claim departments by advising them relative to claims of a fraudulent nature, which have been brought against different companies, and thus keep them posted as to what kind of fradulent claims are being brought. The association also proposes to assist the claim agents in their out-of-town claims.

As announced in the previous issue, the present membership fee in the association is $5 a year, but at the next meeting of the executive committee, which will be held early next year, the dues will probably be increased.

## NIAGARA POWER IN SYRACUSE IN EIGHTEEN MONTHS

In regard to the use by New York Central interests in Central New York of power developed at Niagara Falls by the Ontario Power Company, General Manager Connette, of the Syracuse Rapid Transit Company, is quoted as saying:

"In eighteen months our cars will be running with Niagara power, I expect. The power will be brought to Syracuse over high-tension wires along the Central's right of way, in all probability. There will be some waste of power from the resistance of 160 miles of wire, but notwithstanding that it will be cheaper than the system of steam power houses along the route. It will be alternating current, of course, and the new cars on the interurban portion of the system will be equipped with single-phase alternating-current motors, provided with transformers on the cars, which will make it possible for the cars to be run with the direct current within the city limits.

"It may be that the alternating current will be transformed in our local power plant to a direct current, so that the present motor equipment of our rolling stock in the Syracuse system will still be available. The power house in Syracuse probably will not be dismantled, but will be kept for use in case of an emergency. But the new system will result in a great economy of operation, as there will be a saving in fuel, water and other particulars, including, perhaps, a reduction in the number of persons employed in the power department."

Mr. Connette is also quoted as saying that the link of the West Shore from Utica to Syracuse is now being equipped for electric power, and that there would be an hourly service between the two cities, with shorter headway later if the traffic demanded it.

## ANNUAL REPORT OF THE AMERICAN RAILWAYS COMPANY FOR THE FISCAL YEAR ENDING JUNE 30, 1904

The fifth annual report of the American Railways Company, for the year ending June 30, 1904, was presented at the annual meeting of the stockholders of the company, held in Camden, N. J., a few days ago. In presenting the report, President Sullivan said:

The gross earnings of the subsidiary companies were $1,406,965.44, an increase over 1903 (being a gain of 13 per cent) of $161,667.94.

After paying all fixed charges, interest and taxes, the net income is $270,462.65, a decrease of but $4,229.05 from the previous year, notwithstanding the increased cost of operation due to the increase in the wages of conductors and motormen, and in the cost of fuel.

Dividends were paid to the stockholders of The American Railways Company amounting to $234,180, an increase over dividends paid last year of $10,406, leaving a balance of $36,282.65 to be added to the credit of surplus account shown in 1903 of $381,783.15, which makes the balance to the credit of the surplus account on June 30, 1904, $418,065.80.

The total number of passengers carried was 31,475,692, being an increase for the year of 3,658,734.

During the year we have expended the following:

Springfield, Ohio. The Springfield Railway Company. New machinery for power house and for improvement of tracks, $60,-071.63.

Dayton, Ohio. The People's Railway Company. Track extensions and betterments amounting to $233,687.12. This includes the cost of four new trucks with double-motor equipments.

Altoona, Pa. Altoona & Logan Valley Electric Railway Company. We made an addition to the power house and installed two 300-hp boilers and two condensing engines of 750 hp each, direct-connected to two 500-kw generators. We also erected a cistern at this place.

We remodeled the repair shops, built a new storehouse, built new stables for trolley wagons and horses; completed the Fairview extension and have it now in operation; and we have improved the roadway on the Tyrone division, all at a total cost of $227,634.32.

Bridgeton, N. J. Bridgeton & Millville Traction Company. We bought additional motor equipment and reduced the grade on the Port Norris extension by cutting down Donaghy's Hill. These two items cost $13,282.90.

The total cost of the above improvements amounted to $534,-675.97.

During the year we sold $50,000 of the bonds of The People's Railway Company, of Dayton, Ohio, which were in the treasury of the company.

We merged and consolidated the City Passenger Railway Company of Altoona, Pa., with the Tyrone Electric Railway Company and the Altoona & Logan Valley Electric Railway Company under the style and title of Altoona & Logan Valley Electric Railway Company, which consolidated company acquired all but twenty shares of the stock of the Home Electric Light & Steam Heating Company, of Tyrone, Pa., and leased the Electric Light Company for ninety-nine years.

On Aug. 15, 1903, Altoona & Logan Valley Electric Railway Company created a mortgage on its property for the sum of $4,000,-000, and issued 4½ per cent thirty-year gold bonds; $1,000,000 of the bonds being reserved in the hands of the trustee for future extensions; and $500,000 of the bonds were placed with the trustee to take up the present issue of $470,500 5 per cent mortgage bonds of the Altoona & Logan Valley Electric Railway Company. Of the remaining $2,500,000 bonds, $500,000 have been sold, and with part of the proceeds we paid off the entire mortgage indebtedness of the Tyrone division, amounting to $275,000, and all of the first mortgage bonds on the City Passenger Railway Company, amounting to $50,-000, which was the only indebtedness of that company.

By resolution of the board of directors, the "cost" value of the preferred and common stocks of the Chicago Union Traction Company has been reduced on the books of the company from $500,000, the actual cost thereof, to $146,250, the actual market value on June 30, 1904, being at the rate of $27 per share for the preferred stock and $4.50 per share for the common stock. Against this reduction of $353,750 the American Railways Company has in its treasury an increased amount of income bearing and salable securities of its subsidiary companies, notably in the securities of the Altoona & Logan Valley Electric Railway Company growing out of appreciation in their value, of a market value in excess of the amount thus charged to profit and loss. The stockholders will note that, with these two exceptions, the assets of the company are carried at the actual cost thereof, notwithstanding the large increase in the value and earning power of the same.

During the past year the increased cost of operating the plants of the different properties of the company amounted to $158,-306.01; the major portion of which was due to the increase in wages of conductors and motormen; and to the increased cost of fuel.

TREASURER'S REPORT FOR FISCAL YEAR ENDING JUNE 30, 1904

INCOME

| | | |
|---|---|---|
| Interest and dividends on bonds and stocks owned by the company | $333,671 | |
| *Miscellaneous income | 109,525 | |
| Gross income | | $443,196 |
| **DEDUCTIONS FROM INCOME** | | |
| General expenses | $40,144 | |
| Printing and registration of stocks and bonds | 1,052 | |
| Legal expenses | 250 | |
| Taxes | 8,381 | |
| Interest on funded debt | 122,400 | |
| Depreciation of office furniture and fixtures and of engineering department instruments | 507 | |
| Total deductions from income | | $172,734 |
| Net income | | $270,462 |
| Dividends paid | | 234,180 |
| Surplus | | $36,282 |
| Profit and loss account, balance June 30, 1903 | | 381,783 |
| Surplus June 30, 1904 | | $418,065 |

* Chiefly interest on advances made to sub-companies and deducted from their earnings before dividends were declared.

GENERAL BALANCE SHEET FOR FISCAL YEAR ENDING JUNE 30, 1904

ASSETS

| | Total Issue | Owned by the A. R. Co. | Value on A. R. Co. Books |
|---|---|---|---|
| The Springfield Railway Company first-mortgage bonds, 6 per cent | $500,000 | $500,000 | $500,000 |
| The Springfield Railway Company income bonds, 5 per cent | 100,000 | 99,791 | 79,829 |
| The Springfield Railway Company capital stock | 1,000,000 | 953,100 | 57,469 |
| Bridgeton Electric Company capital stock. | 25,000 | 25,000 | 17,271 |
| Bridgeton & Millville Traction Company capital stock | 200,000 | 200,000 | 159,364 |
| The People's Railway Company capital stock | 1,100,000 | 1,100,000 | 1,334,229 |
| The Springfield Light & Power Company capital stock | 200,000 | 200,000 | 192,111 |
| Altoona & Logan Valley Electric Railway Company capital stock | 1,500,000 | 1,500,000 | 403,750 |
| Du Page Construction Company capital stock | 25,000 | 25,000 | 25,000 |
| Franklin Real Estate Company capital stock | 10,000 | 10,000 | 10,000 |
| Chicago Union Traction Company capital stock (preferred and common) | ...... | ...... | 146,250 |
| Total cost of stocks and bonds | | | $2,925,272 |
| *Bills receivable, accounts receivable, etc | | | 4,865,311 |
| Office furniture and fixtures | | | 3,216 |
| Engineering department instruments | | | 1,347 |
| Discount on loans, paid but not due | | | 5,496 |
| Interest on bonds owned, accrued but not due | | | 52,871 |
| Cash on hand | | | 43,988 |
| | | | $7,897,500 |

* Chiefly advances to subsidiary companies.

LIABILITIES

| | |
|---|---|
| Capital stock | $3,903,000 |
| Collateral trust convertible gold 5 per cent bonds | 2,448,000 |
| Bills payable | 1,104,291 |
| Vouchers payable | 5,551 |
| Accident insurance fund | 3,094 |
| Insurance reserve fund | 1,618 |
| Interest accrued but not due on funded debt | 10,200 |
| Taxes accrued but not due | 3,680 |
| Profit and loss, surplus as per operating report | 418,066 |
| | $7,897,500 |

STOCKS OWNED BY THE AMERICAN RAILWAYS COMPANY, JUNE 30, 1904

| Name of Company | Shares | Each | Total Par |
|---|---|---|---|
| Altoona & Logan Valley Electric Railway Co. | 30,000 | $50 | $1,500,000 |
| Bridgeton Electric Company | 250 | 100 | 25,000 |
| Bridgeton & Millville Traction Company | 4,000 | 50 | 200,000 |
| Chicago Union Traction Company, preferred | 5,000 | 100 | 500,000 |
| Chicago Union Traction Company, common | 2,500 | 100 | 250,000 |
| Du Page Construction Company | 250 | 100 | 25,000 |

| Name of Company | Shares | Each | Total Par |
|---|---|---|---|
| The People's Railway Company | 11,000 | 100 | 1,100,000 |
| The Springfield Railway Company | 9,531 | 100 | 953,100 |
| The Springfield Light & Power Company | 2,000 | 100 | 200,000 |
| The Franklin Real Estate Company | 100 | 100 | 10,000 |
| | | | $4,763,100 |

BONDS OWNED BY THE AMERICAN RAILWAYS COMPANY, JUNE 30, 1904

| | |
|---|---|
| The Springfield Railway Company first-mortgage gold 6s | $500,000 |
| The Springfield Railway Company income mortgage gold 5s | 99,700 |
| The Springfield Railway Company income script | 92 |
| | $599,792 |

SUMMARY

| | |
|---|---|
| Par value of stock | $4,763,100 |
| Par value of bonds | 599,792 |
| | $5,362,892 |
| Value (as per general balance sheet) | 2,925,272 |

STOCK OWNED BY SUBSIDIARY COMPANIES, JUNE 30, 1904

Bridgeton & Millville Traction Company:

| Name of Company | Shares | Each | Total Par |
|---|---|---|---|
| Bridgeton Rapid Transit Company | 1,000 | $100 | $100,000 |
| Bridgeton & Deerfield Turnpike Company | 284 | 25 | 7,100 |
| Bridgeton & Millville Turnpike Company | 377 | 25 | 9,425 |
| Being all of the capital stock of the above companies | | | $116,525 |

Altoona & Logan Valley Electric Railway Company:

| | | | |
|---|---|---|---|
| The Home Electric Light & Steam Heating Co. | 780 | $50 | $39,000 |
| The Lakemont Park Company | 1,200 | 50 | 60,000 |
| The Logan Valley Land Company | 360 | 50 | 18,000 |
| | | | $117,000 |

Du Page Construction Company:

| | | | |
|---|---|---|---|
| Chicago & Joliet Electric Railway Company | 23,000 | $100 | $2,300,000 |
| Chicago & Desplaines Valley Electric Railway Company | 11,000 | 100 | 1,100,000 |
| | | | $3,400,000 |

BONDS OWNED BY SUBSIDIARY COMPANIES, JUNE 30, 1904

Bridgeton & Millville Traction Company:

| | |
|---|---|
| Bridgeton Electric Company first-mortgage gold 5s | $250,000 |

Du Page Construction Company:

| | |
|---|---|
| Chicago & Joliet Electric Railway Company Consolidated mortgage gold 5s | $1,600,000 |
| Chicago & Desplaines Valley Electric Railway Company first-mortgage gold 5s | 1,000,000 |
| | $2,600,000 |

## WORK ON THE TRENTON, NEW HOPE & LAMBERTVILLE LINE

The grading on the Trenton, Newhope & Lambertville Street Railway, which is being built between Yardley, Pa., and Newhope and Lambertville by the New Jersey & Pennsylvania Traction Company, is nearing completion. The average gradient between Yardley and Lambertville will not exceed 5 ft. or 6 ft. to the mile, and in the whole line from Trenton to Lambertville there will be less than 65 ft. difference in the elevation for the whole 16 miles. The maximum degree of curvature will be 4 degs. (or 1432.5 ft. radius). The rails are standard "T", weighing 80 lbs. to the yard, and each 30 ft. long, laid upon 6 x 8 x 8 ties, spaced 30 ins. to centers. The road is being built almost entirely upon a private right of way, and is of the most substantial construction. In one place, 2 miles above this borough, the whole side of a hill is being blasted away to make room for the public highway, which will be moved over to make place for the railway track. In this one place, alone, Engineer A. B. Nelson states that he will remove 40,000 cubic yards of solid rock. A portable crusher is on the ground, and this stone is being converted into ballast for use upon the line. The power house, which will supply high-tension alternating current, according to present plans, will be located at Yardley, and will supply the New Jersey & Pennsylvania Traction Company's Tre[illegible]-Newton-Newhope lines. It is expected that cars about 45 ft. in length, and capable of running at 45 or 50 miles per hour, will be placed on the line in the spring, when it is expected to be ready for operation. The design of the cars has not been definitely decided, however.

Judge Fisher, in the St. Louis Circuit Court, has enjoined Brown Bros. & Company, of New York, from putting in force their reorganization plan for St. Louis Transit. The writ was granted on the petition of holders of 11,000 shares of the company and is returnable Nov. 11.

## NEW PLAN FOR GARBAGE COLLECTION IN WORCESTER

A new plan for the collection of garbage was recently proposed in Worcester, Mass., by Superintendent Schonler, of the Home Farm, at the annual inspection by the city government. The population of Worcester is now about 140,000, and the present system of garbage collection is operated by fifteen two-horse wagons with two men to each team. The city is growing rapidly, and the constant increase in this force makes it an expensive matter properly to dispose of the refuse. The teams are now put up over night at the Home Farm, which is about 3 miles from the center of the city. There is a long grade to climb in each direction, and it is a heavy day's work for a team to leave the farm, collect the garbage, return and unload at the farm, twice. At the farm the garbage is fed to hogs.

The new scheme is to have the teams deliver their loads at a central point in Worcester, from which it will be taken to the farm in an air-tight trolley car of the Consolidated Street Railway Company. The main line of the electric route to Clinton and Fitchburg passes within a few hundred feet of the farm, so that it will be an easy matter to run a spur track to the sties. Not only will the scheme, if carried out, save wear and tear on the horses; it will eliminate the inefficient return trips amounting to about 75 to 90 wagon miles per day; do away with the offensive odors which have long been suffered by the Lincoln Street residents along the route, and, finally, will enable much more work to be done by the present outfit of teams than is at present accomplished.

## IMPROVEMENTS IN BROOKLYN

In reply to questions, President Winter, of the Brooklyn Rapid Transit, says that the State Railroad Commission's recommendations of January 28, 1903, have all been carried out, so far as they related to the Brooklyn Heights Railroad. In the same period Brooklyn Rapid Transit has spent in various improvements more than $4,000,000, and will spend much more as fast as the present equipment can be changed.

President Winter says further: "The nine units of electric power which were in process of construction at the date of the Railroad Commissioners' report, namely, January 28, 1903, are completed and in operation. Since that time, the capacity of some of the other power houses has been increased by various improvements. Car service as compared with that of 1902 may, perhaps, be best explained by the statement that, although the present carrying capacity of many of our cars is much larger than in that year, the car mileage for six months ending September 30, 1904, is 2,990,353 greater than in the corresponding period of 1902, with no practical increase of track mileage. When the temperature falls to 45 degs., the company will now, it is believed, barring unforeseen disability of engines, be able to heat all cars, surface and elevated.

"We are operating full electric service on the elevated lines, excepting the evening rush hours, when seven five-car trains between Broadway and the Brooklyn Bridge, on the Lexington Avenue line, are still operated with steam locomotives. These will be displaced by electric operation as soon as the cars can be properly equipped. All cars are lighted by electricity, except possibly eight or ten coaches operated by steam service, and which we have not yet been able to put through our overcrowded shops.

"The work of constructing electric conduits in which are installed high-tension current feeder lines is steadily progressing. It may interest you to know that to this date over $1,019,000 has been expended for that work. More is left to be done, and the work will be pushed forward as rapidly as practicable.

"In this connection I may mention the construction of our new power house adjoining the Eastern District station on Kent Avenue, the foundation of which is well advanced. This house will have an ultimate capacity of 100,000 hp. The first installation will consist of two turbo-units of 5550 kw, or about 8000 hp each, and are expected to be available for winter service of 1905.

"But as the company's rolling stock is a somewhat conspicuous feature in the streets of Brooklyn, more or less importance is naturally attached to its condition and appearance. It may, therefore, be of interest, to know that within this period 220 new elevated cars have been purchased, the last 100 of which are rapidly going into service. Two hundred and fifty-four of the old elevated cars have been entirely rebuilt after the most approved manner and equipped with the best known appliances for electric operation, all at a cost of over $4,000,000. The remainder of the elevated equipment will go through this process as fast as the shop capacity of the company will allow."

## SUBWAY FOR CHICAGO PREDICTED

At a recent banquet of the real estate board of Chicago Alderman Foreman, chairman of the local transportation committee, is reported to have stated his belief that work would be begun on a comprehensive subway system for Chicago before April, 1906. The tunnel, if the present plans are carried out, Mr. Foreman said, would be divided into four compartments. Two of these would be used for railways, the other two for water pipes and electric cables. The system would extend to Twelfth Street, on the south, as far north as Chicago Avenue, and west to Halsted Street.

## INTERURBAN RAILWAYS DEFINED IN IOWA

The Supreme Court of Iowa has finally rendered its decision in the case of the Executive Council of the State of Iowa vs. the City of Cedar Rapids, deciding that the Cedar Rapids & Marion City Railway is an interurban line and must be assessed for taxation purposes by the Executive Council. The authorities of the City of Cedar Rapids applied to the district court of Linn County for an order setting aside the assessment which the Executive Council had certified to the Board of Supervisors of Linn County as a basis for the taxation of the property of said company. This order was issued by Judge Thompson, and the case was then appealed to the Supreme Court. The Supreme Court has reversed the decision of Judge Thompson. The court holds that the interurban law passed in 1902 alters the status of those lines which are operated by interurban companies, both within and without the city limits. In most cases here in Iowa a different company operates the interurban end of a street railway line, as in Des Moines. But in the case in question the same company operates within the cities of Cedar Rapids and Marion, and in the country between said cities.

The court in the decision rendered said:

"Section 2033-a defines an interurban railway and, as we have seen, the railway in question comes within the definition given. Such definition is recognized by Sec. 2033-c and must be accepted as confirmatory of the intention to classify all railways coming within the definition found in Sec. 2033-a as interurban railways. Otherwise, and accepting the argument for appellee (the railway) as sound, in the instant case we have to deal with an interurban railway as to that portion of the line extending through Marion township, and distinctively a street railway as to those portions of the line being within the limits of the cities and towns named. We cannot think any such result was intended.

"The Legislature was dealing with lines of interurban railway and, indeed, the definition found in the statute agrees with the common understanding. Both agree that an interurban line is one extending from within the limits of one city or town to and within the limits of another city or town. And it is not conceivable that it was the purpose of Sec. 2033-c to provide that an interurban line is not an interurban line save only from city or town limits to city or town limits. To say otherwise would not only invlove a contradiction of terms, but it would lead to a most absurd result and neither of such is to be considered as within the intention of the Legislature.

"As we read the statute, it means that as to those portions of its line being within city and town limits a corporation operating an interurban railway shall in respect of the operation of its line be held to the rights and obligations of a street railway only. The character of the line as an interurban railway is not changed, but it is to be subject to the laws governing street railways. The statute simply recognizes the necessary existence of differences in the matter of regulation between urban and subruban districts, and this by general law, or in the case of the former, by municipal ordinance."

## REPORT OF ENGINEER AS TO ELECTRICITY ON SOUTHERN PACIFIC

The electrical engineer of the Southern Pacific Company has submitted to General Manager H. C. Markham plans to convert the ferry steam roads and the South Pacific Coast Narrow Gauge road, as far south as San Jose, into electric roads, together with estimates of cost for construction and the cost of obtaining electric power from the Bay Counties Power, and the Standard Electric Company.

The statement comes from Omaha that within three months the Union Pacific Railroad Company will have in operation several gasoline motor cars between that city and local stations on its Nebraska line. An order is said to have been placed for material for the construction of the new cars, and they will be built in the shops in Omaha as quickly as possible.

## PLANS TO DEADEN NOISE ON THE CHICAGO ELEVATED ROADS

Two methods of deadening the noises on the elevated roads have been presented to the sub-committee of the local transportation committee. One, presented by J. B. Strauss, proposed encasing the existing structure in concrete. The present ties would be removed and the rails supported on beams of creosoted wood, laid longitudinally on a bed of sand or some other cushion. This in turn would be laid in a trough formed by cement walls resting on the top of the structure. Cement cross-ties would be used to bind the structure together. Frederick Merritt of the India Asphalt Company proposed to encase the steel structure in a casing of from one to two inches of asphalt.

## ORDERS FOR THERMIT JOINTS

The Goldschmidt Thermit Company states that the following companies in the United States have ordered and are using Thermit for welding their rail joints: New York City Railway Company, Brooklyn Height Railroad Company, Public Service Corporation of New Jersey (Camden Branch), Detroit United Railway Company, Cleveland Electric Railway Company, Chicago City Railway Company, Fitchburg (Mass.) Railway Company, Holyoke (Mass.) Railway Company, Schenectady Railway Company, Birmingham Railway, Light & Power Company, Hartford Street Railway Company. The number of joints being made by these companies vary from 100 to 1000, and several have placed second orders.

## IMPROVEMENTS AT FORT WAYNE

Important improvements are to be made to the properties of the Fort Wayne & Wabash Valley Traction Company and the Fort Wayne Light & Power Company and subsidiary properties. The changes to be made were decided upon after a thorough inspection of the properties by W. Kesley Schoepf, of Cincinnati, Charles M. Murdock and other representatives of the United Gas & Improvements interests. Accompanied by Dr. Louis Duncan, of New York, as professional adviser, they went over the entire system.

As a result, a new power station is to be built, buffet cars are to be put on between Fort Wayne and Indianapolis; a terminal station is to be built in Fort Wayne, the electric light and power lines are to be extended, and important new street railway lines are to be built in the city. In regard to these improvements Mr. Schoepf said: "We have decided to erect in Fort Wayne a power plant to cost between $800,000 and $1,000,000. It will be of sufficient magnitude to supply power for the city traction lines, the local light and power company, our interurban lines as far west as Logansport, and lines contemplated east, north and south, for our policy is not only to build interurban lines ourselves, but to promote and encourage the building of interurban lines by others, for we feel that every line that enters Fort Wayne adds to the population and the commercial interests of the city. * * * Dr. Duncan is authorized to prepare plans for the power house and equipment which will not only fill present demands, but will be of sufficient magnitude to take care of the future. We will abandon the Spy Run Avenue station and the water power. Our new power house will be in touch with the railroads, so as to be able to receive our coal direct from the mines. * * * The object in coming to Fort Wayne on a special car from Indianapolis was to test the feasibility of a through car service from Fort Wayne to the capital. We have determined to install it as soon as we can eliminate certain short curves and solidify the track between here and Wabash. We mean to put on a five-hour, or at the outside a five and a half hour service, between Fort Wayne and Indianapolis. The cars will be the latest and most improved pattern. They will include the regular passenger compartment, a smoking room, a Pullman buffet service, and other features that will make traveling over the line a luxury.

"The line to Indianapolis will be through Huntington, Wabash, Peru, Kokomo and Noblesville, but not through Logansport. We feel that Fort Wayne and other cities will appreciate this service, for it means much for the people.

"We have, as you can see by the maps here, considered changes in the local traction lines, calculated, as we believe, to improve the service, and we will submit them to the city officials for consideration and approval. They may mean the abandonment of certain tracks and the extension of others to enable us to carry the people to and from their homes on a faster schedule."

## PROGRESS ON THE BLOOMINGTON, PONTIAC & JOLIET ELECTRIC RAILWAY

The Bloomington, Pontiac & Joliet Electric Railway Company has closed a contract with the American Car Company for two passenger coaches to be used upon the line between Pontiac and Dwight. One of the cars which it purchased is now on exhibition in the Transportation Building at the World's Fair, where it can be seen by anyone interested, in the display of the J. G. Brill Company, about the middle of the building. This coach is most handsomely finished throughout, the inside finish being of richly inlaid mahogany. The seats are fitted with high backs and are upholstered with plush. The curtains are of pantasote lined with silk. The car will seat forty-four people, and has extra large platforms divided with railings to provide extra standing room. It is considered by all the most handsome electric car in the extire exhibit. The other car is to be built of special design, and while not so handsomely finished as the prize car secured from the Exposition, it will compare very favorably with it. This car will have a compartment for smoking, as well as space for baggage and express packages.

Following the advice of the Arnold Electric Power Station Company, the consulting engineers and constructors of the line, it has been decided to equip the cars with single-phase motors furnished by the General Electric Company, this being the first road upon which these motors will be operated outside of the experimetnal line upon which their success has been demonstrated. The motors will be delivered in time to equip the cars by Dec. 1. As the building of the road is progressing very rapidly, there is every reason to believe from present indications that the railway company will have the electric line in operation as a Christmas present to Pontiac.

## DEPRECIATION MONEY IN CHICAGO

Judge Grosscup has directed that 22 per cent of the earnings of the north side lines, and 24 per cent of the earnings of the west side lines be set aside as a depreciation fund before any payment of dividends be made to the north and west Chicago Street Railroad stockholders. This settles the dispute which arose between the Chicago Union Traction Company and the stockholders of the underlying companies as to what amount should be set aside before the underlying companies get their dividends.

## NORTH GEORGIA ELECTRIC PLANS IMPORTANT WORK

The officers and the directors of the North Georgia Electric Company, controlling the Gainesville & Dahlonega Electric Railway Company, have been in session at Gainesville, Ga., relative to the business policy of the company. As a result of their meeting several important projects are to be taken up by the company at once. One of the things decided on is the construction of a sanitarium on the company's property on the Chattahoochee Park line. This will probably call for an expenditure of $50,000. Another improvement that it is proposed to carry out is the construction of a hotel on an eminence overlooking the river, just this side of Chattahoochee Park. Still another improvement is the construction of the electric railway between Gainesville and Dahlonega. The question of power development was also considered, but no decision was reached as to the proper course to pursue in this matter. It is known that the advisability of water-power development was considered.

## THE ANNUAL MEETING OF THE A. S. M. E.

The programme is announced for the annual meeting of the American Society of Mechanical Engineers, to be held at the home of the society, 12 West Thirty-First Street, New York, in December. The opening session will occur on Tuesday evening, Dec. 6, at 9 p. m. President Ambrose Swasey will deliver the annual address, the subject being "Achievements of the Engineer with Respect to Exact Measurements." The second session will occur on Wednesday morning at the Hall of Mendelssohn Union, 113 West Fortieth Street, at 9.30 o'clock. This will be the business session of the convention, and the following professional papers will also be presented: "A New Hydraulic Experiment," by A. F. Nagle; "A Twist Drill Dynamometer," by W. W. Bird and H. P. Fairfield; "Diamond Tools," by G. C. Henning. Following this, luncheon will be served at the society house and the afternoon will probably be spent in making excursions to various power stations and points of interest. The evening of this day has been left free for the members to make their own engagements.

The third and fourth sessions will take place at Mendelssohn Union, on Thursday. At the morning session the following professional papers will be considered: "Centrifugal Fans," by A. J. Bowie, Jr.; "Computation of Values of Water Powers and Damages Caused by Diversion of Water Used for Power," by Charles T. Main; "An Indicating Steam Meter," by Charles E. Sargent; "Stay Bolts, Braces and Flat Surfaces: Rules and Formulæ," by Robert S. Hale; "Condensers for Steam Turbines," by George I. Rockwood.

At the afternoon session the professional papers will be as follows: "Bursting of Four-Foot Fly-Wheels," by Charles E. Benjamin; "Influence of the Connecting Rod upon Engine Forces," by Sanford A. Moss; "Losses in Non-Condensing Engines," by James B. Stanwood; "Power Plant of Tall Office Buildings," by Stirling H. Bunnell; "Pressures and Temperatures in Free Expansion," by A. Bordody and R. C. Carncross (presented by Charles E. Lucke). Between the morning and afternoon sessions luncheon will be served at the society house.

The usual reception for guests and friends will be held at Sherry's on Thursday evening at nine o'clock, and will be followed by dancing and supper.

The closing session will be held at the society house on Friday morning, Dec. 9, at ten o'clock. Following are the papers that will be considered: "Fuel Consumption of Locomotives," by George R. Henderson; "Road Tests of Brooks Passenger Locomotives," by E. A. Hitchcock; "Discharge of Water with Steam from Water Tube Boilers," by A. Bement; "More Exact Method for Determining the Efficiency of Steam Generating Apparatus," by A. Bement; "Forcing Capacity of Fire Tube Boilers," by Francis W. Dean.

The list of officers to be voted for, as presented by the nominating committee of the society, is as follows: For president, John R. Freeman, Providence, R. I.; for vice-presidents, S. M. Vauclain, Philadelphia, H. H. Westinghouse, Pittsburg, Fred W. Taylor, Philadelphia; for treasurer, William H. Wiley, New York, N. Y.; for managers, George M. Brill, Chicago, Fred J. Miller, New York City, Richard H. Rice, Lynn, Mass.

## NEW PUBLICATIONS

Traction Development, paper; 45 pages, illustrated. Published by the Transit Finance Company, of Philadelphia and New York.

This book has been published for gratuitious distribution among investors by the company mentioned, with the thought that the facts contained therein, with the conclusions, may serve as an education regarding the desirability of traction securities. It is devoted principally to a discussion of the advantages of high-speed, high-class interurban railways. Statistics are given of the earnings of certain roads and rules are suggested for determining the earning power of proposed lines. Among the latter it is stated that in general "less than 500 inhabitants to the mile will not warrant the construction of a first-class double track line. In estimating the population tributary to an interurban line, it is not advisable to include the terminals, though it is considered proper to count that portion of the terminal population residing within one-half mile of the entrance lines into the cities." Figures on the number of companies, miles of track and capitalization per mile of the electric railway companies in the different States, taken from the United States Census Report, are also given.

## PERSONAL MENTION

MR. GEORGE HILLMANN WHITFIELD, electrical and mechanical engineer of the Virginia Passenger & Power Company, of Richmond, Va., was married Oct. 26 at Baltimore, Md., to Miss Laura Merryman.

DR. HANS GOLDSCHMIDT, who recently returned to Germany, has been conferred the Elliott Cresson medal by the Franklin Institute, of Philadelphia, for his efforts in behalf of science in the discovery of thermit.

MR. WALTER ROSS has resigned as claim agent of the Detroit United Railway Company, of Detroit, Mich., to resume the practice of law. Mr. F. E. Rankin has been appointed to succeed Mr. Ross. Mr. Rankin formerly was in charge of the claim department of the Grand Trunk Railway.

PRESIDENT HERBERT H. VREELAND, of the New York City Railway Company, is the subject of an interesting biographical sketch by Henry M. Hyde in the current number of "The Technical World." The sketch is one of a series entitled "Life Stories of Successful Men," and is accompanied by an excellent portrait of Mr. Vreeland.

# 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. ‡ Report of street ry. only.

| 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 | 1 m., Sept. '04 | 80,785 | 41,353 | 39,432 | 22,666 | 16,766 |
| | 1 " " '03 | 84,015 | 43.918 | 40,097 | 22,707 | 17,390 |
| | 9 " " '04 | 669,714 | 363,683 | 306,031 | 203,658 | 102,373 |
| | 9 " " '03 | 666,302 | 361,950 | 304,352 | 199,665 | 104,687 |
| AURORA, ILL. Elgin, Aurora & Southern Tr. Co | 1 m., Sept. '04 | 38,886 | 21,432 | 17,454 | 9,333 | 8,121 |
| | 1 " " '03 | 40,446 | 22,056 | 18,390 | 9,173 | 9,218 |
| | 3 " " '04 | 127,259 | 63,887 | 63,372 | 27,839 | 35,533 |
| | 3 " " '03 | 138,051 | 71,581 | 63,470 | 27,518 | 35,952 |
| BINGHAMTON, N. Y. Binghamton Ry. Co | 1 m., Sept. '04 | 22,418 | 12,599 | 9,818 | ------ | ------ |
| | 1 " " '03 | 21,932 | 10,657 | 11,274 | ------ | ------ |
| | 9 " " '04 | 78,817 | 37,191 | 41,626 | 20,941 | 20,685 |
| | 9 " " '03 | 73,507 | 33,998 | 39,509 | 19,108 | 20,401 |
| BUFFALO, N. Y. International Tr. Co | 1 m., Sept. '04 | 384,961 | 193,195 | 191,766 | 136,383 | 55,383 |
| | 1 " " '03 | 377,922 | 201,041 | 176,881 | 127,445 | 49,435 |
| | 3 " " '04 | 1,224,585 | 573,129 | 651,456 | 416 883 | 234,573 |
| | 3 " " '03 | 1,198,316 | 592,926 | 605,390 | 398,971 | 206,419 |
| CHICAGO, ILL. Aurora, Elgin & Chicago Ry. Co | 1 m., Sept. '04 | 46,786 | 22,868 | 23,918 | ------ | ------ |
| | 3 " " '04 | 158,857 | 76,129 | 82,728 | ------ | ------ |
| Chicago & Milwaukee Elec. R. R. Co | 1 m., Sept. '04 | 53,712 | 17,396 | 36,316 | ---- | ------ |
| | 1 " " '03 | 40,921 | 9 820 | 31,101 | ------ | ------ |
| | 9 " " '04 | 324,277 | 125,744 | 198,533 | ------ | ------ |
| | 9 " " '03 | 194,636 | 66,936 | 127,700 | ------ | ------ |
| Northwestern Elevated R. R. Co | 12 m., June '04 | 1,724,929 | 566,076 | 1,158,853 | 955,599 | 203,254 |
| | 12 " " '03 | 1,642,456 | 517,441 | 1,125,015 | 941,605 | 183,410 |
| CINCINNATI, O. Cincinnati, Dayton & Toledo Tr. Co | 1 m., Sept. '04 | 47,581 | 22,774 | 24,807 | 16,330 | 8,477 |
| | 1 " " '03 | 49,983 | 23,401 | 26,583 | 16,000 | 10,583 |
| | 4 " " '04 | 197,404 | 105,167 | 92,238 | 66,052 | 26,186 |
| | 4 " " '03 | 201,661 | 99,586 | 105,075 | 64,291 | 40,784 |
| CLEVELAND, O. Cleveland, Painesville & Eastern, R. R. Co | 1 m., Sept. '04 | 23,157 | 12,701 | 10,456 | ------ | ------ |
| | 1 " " '03 | 23,023 | 12,973 | 10,050 | ------ | ------ |
| | 9 " " '04 | 172,190 | 102,153 | 70,031 | ------ | ------ |
| | 9 " " '03 | 164,886 | 94,008 | 70,878 | ------ | ------ |
| Cleveland & Southwestern Traction Co | 1 m., Sept. '04 | 46,289 | 25,908 | 20,381 | ------ | ------ |
| | 1 " " '03 | 43,159 | 25,330 | 17,829 | ------ | ------ |
| | 9 " " '04 | 353,072 | 224,139 | 128,933 | ------ | ------ |
| | 9 " " '03 | 330,232 | 194,739 | 135,493 | ------ | ------ |
| Lake Shore Electric Ry. Co | 1 m., Sept. '04 | 67,465 | 36,661 | 30,804 | ------ | ------ |
| | 1 " 03 | 63,499 | 36,639 | 26,859 | ------ | ------ |
| DETROIT, MICH. Detroit United Ry | 1 m., Sept. '04 | 424,478 | *234,585 | 189,893 | 89,802 | 100,091 |
| | 1 " " '03 | 413,639 | *233,596 | 180,043 | 84,208 | 95,835 |
| | 9 " " '04 | 3,417,451 | *2074705 | 1,342,746 | 803,069 | 539,677 |
| | 9 " " '03 | 3,333,622 | *1947478 | 1,386,144 | 743,762 | 642,382 |
| DULUTH, MINN. Duluth St. Ry. Co | 1 m., Sept. '04 | 50,958 | 23,477 | 27,481 | 16,509 | 10,972 |
| | 1 " " '03 | 51,577 | 28,094 | 23,483 | 15,832 | 7,651 |
| | 9 " " '04 | 461,894 | 246,300 | 215,594 | 184,470 | 67,124 |
| | 9 " " '03 | 465,261 | 257,041 | 208,220 | 139,085 | 69,135 |
| EATON, IND. Muncie, Hartford & Ft. Wayne Ry. Co | 1 m., Sept. '04 | 17,692 | *6,518 | 11,174 | 4,000 | 7,174 |
| | 9 " " '04 | 134,640 | *63,536 | 71,104 | 39,000 | 32,104 |
| FORT WORTH, TEX. Northern Texas Traction Co | 1 m., Sept. '04 | 46,021 | 25,146 | 20,875 | 10,150 | 10,725 |
| | 1 " " '03 | 41,949 | 22 033 | 19,916 | 9,673 | 10,243 |
| | 9 " " '04 | 405,864 | 226,800 | 179,064 | 91,006 | 88,058 |
| | 9 " " '03 | 335,297 | 178,168 | 157,129 | 82,490 | 74,639 |
| HANCOCK, MICH. Houghton County St. Ry. Co | 1 m., Aug. '04 | 18,811 | 9,828 | 8,983 | 3,454 | 5,529 |
| | 1 " " '03 | 20,871 | 10,256 | 10,614 | 2,929 | 7,685 |
| | 12 " " '04 | 190,106 | 131,409 | 58 698 | 38,338 | 20,360 |
| | 12 " " '03 | 182,103 | 120,595 | 61,508 | 33,850 | 27,658 |
| KANSAS CITY, MO. Kansas City Ry. & Lt. Co‡ | 12 m., May '04 | 3,403,125 | 1,880,008 | 1,523,117 | 1,163,135 | 359,982 |
| LONDON, ONT. London St. Ry. Co | 1 m., Sept. '04 | 20,250 | 10,771 | 9,480 | 2,565 | 6,915 |
| | 1 " " '03 | 19,536 | 10,308 | 9,228 | 2,432 | 6,796 |
| | 9 " " '04 | 137,109 | 93,838 | 43,271 | 21,911 | 21,361 |
| | 9 " " '03 | 132,517 | 83,756 | 48,761 | 19,872 | 28,889 |
| MILWAUKEE, WIS. Milwaukee El. Ry. & Lt. Co | 1 m., Sept. '04 | 281,516 | 128,491 | 153,024 | 79,153 | 73,871 |
| | 1 " " '03 | 272,346 | 135,460 | 136,887 | 75,286 | 61,601 |
| | 9 " " '04 | 2,376,095 | 1,193,109 | 1,182,986 | 677,944 | 505,042 |
| | 9 " " '03 | 2,245,436 | 1,128 481 | 1,116,956 | 649,555 | 467,400 |
| Milwaukee Lt., Ht & Tr. Co | 1 m., Sept. '04 | 48,615 | 18,569 | 30,046 | 18,653 | 11,393 |
| | 1 " " '03 | 43,059 | 19,542 | 23,517 | 15.359 | 8,157 |
| | 9 " " '04 | 348,735 | 165 887 | 182,849 | 150,346 | 32,503 |
| | 9 " " '03 | 321,467 | 159,552 | 161,915 | 124,727 | 37,188 |
| MINNEAPOLIS, MINN. Twin City Rapid Transit Co | 1 m., Sept '04 | 373 944 | 166 017 | 207 926 | 91,842 | 116,085 |
| | 1 " " '03 | 372,252 | 156,924 | 215,329 | 78,437 | 136,891 |
| | 9 " " '04 | 3,208,172 | 1,510,168 | 1,698,004 | 817,133 | 880,871 |
| | 9 " " '03 | 3,020,843 | 1,398,887 | 1,621,956 | 705,630 | 916,325 |
| OAKLAND, CAL. Oakland Traction Consolidated | 1 m., Aug. '04 | 106,653 | 56,035 | 50,618 | ------ | ------ |
| | 1 " " '03 | 100,866 | 50,698 | 50,169 | ------ | ------ |
| ROCHESTER, N. Y. Rochester Ry. Co | 1 m., Sept. '04 | 123,278 | 65,049 | 58,229 | 26,360 | 31,868 |
| | 1 " " '03 | 108,312 | 55,401 | 52,911 | 25,742 | 27,168 |
| | 9 " " '04 | 1,107,977 | 608,652 | 499,325 | ------ | ------ |
| | 9 " " '03 | 946,786 | 481 439 | 465,347 | ------ | ------ |
| SAN FRANCISCO, CAL. United Railroads of San Francisco | 1 m., Aug. '04 | 552,234 | ------ | ------ | ------ | ------ |
| | 1 " " '03 | 572,603 | ------ | ------ | ------ | ------ |
| SAVANNAH, GA. Savannah Electric Co. | 1 m., Aug. '04 | 49,932 | 27,376 | 22,556 | 10,645 | 11,911 |
| | 1 " " '03 | 50,756 | 26,859 | 23 897 | 9,804 | 14 093 |
| | 12 " " '04 | 534,342 | 304,148 | 230,194 | 125,649 | 104,545 |
| | 12 " " '03 | 507,791 | 300,288 | 207,503 | 115,721 | 91,781 |
| SEATTLE, WASH. Seattle Electric Co | 1 m., Aug. '04 | 192,368 | 133,935 | 58,433 | 25,358 | 33,074 |
| | 1 " " '03 | 188,541 | 123,829 | 64,712 | 22,257 | 42,455 |
| | 12 " " '04 | 2,246,168 | 1,570,959 | 675,209 | 279,040 | 396,170 |
| | 12 " " '03 | 2,055,425 | 1,456,653 | 598,773 | 286,937 | 311,836 |
| SYRACUSE, N. Y. Syracuse R. T. Co | 1 m., Aug. '04 | 71 328 | 40,192 | 31,136 | 20,132 | 11,004 |
| | 1 " " '03 | 68,569 | 38,002 | 30,567 | 20,288 | 10,279 |
| | 2 " " '04 | 146,619 | 81,075 | 65,544 | 40,454 | 25,090 |
| | 2 " " '03 | 140,515 | 86,693 | 63,822 | 40,355 | 22,467 |
| TERRE HAUTE, IND. Terre Haute Elec. Co. | 1 m., Aug. '04 | 54 426 | 32,315 | 22,111 | 9,640 | 12,471 |
| | 1 " " '03 | 46,255 | 26,818 | 19,438 | 6,665 | 12,773 |
| | 12 " " '04 | 546,633 | 363,738 | 182,895 | 111,398 | 71,497 |
| | 12 " " '03 | 436,387 | 288,895 | 147,492 | 78,391 | 69,101 |
| TOLEDO, O. Toledo Rys. & Lt. Co. | 1 m., Sept. '04 | 150,344 | *79,408 | 70,936 | 41,868 | 29,068 |
| | 1 " " '03 | 150,011 | *78,236 | 71,775 | 41,418 | 30,357 |
| | 9 " " '04 | 1,289,947 | * 692,151 | 597,796 | 375,303 | 222,493 |
| | 9 " " '03 | 1,225,929 | * 631,174 | 594,755 | 366,850 | 227,905 |
| YOUNGSTOWN, O. Youngstown-Sharon Ry. & Lt. Co | 1 m., Aug '04 | 38,617 | *22,181 | 16,436 | ------ | ------ |
| | 8 " " '04 | 302,905 | * 181,844 | 121,061 | ------ | ------ |