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Of this issue of the Street Railway Journal 8500 *copies are printed. Total circulation for* 1906 *to date,* 41,000 *copies, an average of* 8200 *copies per week.*

The Central Electric Railway Association

The amalgamation of the Ohio and Indiana interurban railway associations, at Dayton, Jan. 25, into the Central Electric Railway Association, is an important event in the history of the electric railway industry. Both Ohio and Indiana have played important parts in the development of this class of road, and nowhere else in the world than in these States is interurban railway practice exemplified on a larger scale. The former State has now more miles of electric railway track than any other in the Union, although it is exceeded in population by both New York and Pennsylvania, while Indiana surpasses all States in length of individual lines. After the financial success of interurban railways had been demonstrated in Ohio a few years ago, and before their construction had been taken up to any considerable extent in any other State, it was gravely maintained by a number of students of electric railway economics that the large traffic on the Ohio interurban roads was due to some esoteric reasons which led the people of Ohio to travel frequently from town to town, but that the same results could not be expected after crossing the State line. Mr. Henry, of the Indiana Union Traction Company, and the other pioneers and builders of interurban electric railways in the neighborhood of Indianapolis, proved the falsity of this conclusion, and demonstrated that if the proper service is given, the traffic will follow.

The possibilities of the new association in the way of increasing our knowledge of electric railway practice are immense. In spite of the advance which has been made in interurban electric railroading during the last few years, there are many unsolved problems, and the vigor with which both associations have been conducted in the past is ample warrant for believing that with united energies results will be secured which will be of great benefit to the entire industry. So far both associations have confined themselves, very wisely we believe, to operating questions. There is so much to be done in this line, and the managers themselves are the only ones to do it, that the operating department seems a more fruitful field for study and discussion than construction methods. We wish the association all prosperity in the future.

San Francisco's Street Traffic Problems

The report of Wm. Barclay Parsons on the best solution for the transportation problem in San Francisco, published in our issue of Jan. 6, continues to excite considerable discussion in that city. A number of the members of the Merchants' Association, to whom the report from Mr. Parsons was rendered, are not satisfied with his recommendations, and at a recent meeting made a protest against any expert advice which did not agree with their preconceived opinions. The fact that underground conduit lines were in operation in New York City and Washington seemed to them to be ample proof that the system was most desirable for adoption in the downtown streets of San Francisco. The prime object of any street railway system, viz., that of transporting passengers, was lost sight of by the advocates of the conduit, as it usually is in discussions of this kind. The claim that the trolley system was a disfigurement to the streets, and that it was dangerous to persons and property, formed the main objections to its admission into the center of the city.

This same question has arisen from time to time in deciding upon the equipment of the transportation systems of other large cities, and San Francisco is practically the last in this country which has to face the problem. Those who have the best interests of the city at heart look upon this attempt to compel the adoption of the conduit system as unfortunate. It

is true that New York and Washington have street railways of this character and that their cars are in successful operation, but the local conditions are entirely different. In New York, for instance, the cars do not attempt to run out into the suburbs, and the system on Manhattan Island is so large that the important question of uniformity of equipment has no bearing upon the situation. Washington, also, is a city almost destitute of suburbs, and the problem of through cars and of changes from overhead to conduit is practically eliminated. Again, there is woeful lack of appreciation of the cost of maintenance and renewals on the part of those who advocate the conduit construction. The investment cost of conduit construction is by no means the only one which enters into the difference in expense. The maintenance of the conductors in the conduit may be comparable with that of the overhead system, but the cost of renewals of special work, yokes and conduit, and these all have a definite life, will greatly exceed that pertaining to the trolley system, while the cost of plows is very much greater than that of the collectors on the overhead system. There are other factors which have contributed greatly to the success of the lines in New York and Washington, and which might not and probably would not obtain in any other city. For instance, the drainage is good, the pavements are maintained in excellent condition and the streets are kept very clean by the municipal authorities in both places. But in a city like San Francisco the argument for uniformity of equipment is an overwhelming one, and even if we disregard the item of expense, that point alone should decide the question of the proper system to employ.

More About Trailers

As we have several times noted, there is a strong tendency toward resuming the use of trailers. In general principles it is advantageous, since it enables the car capacity to be doubled while requiring the service of but a single extra man, and the pair of cars practically requires very little more room on the street than a single car. To revert to our principle of the dangerous space carried ahead of every car, the space required for a car upon the street is its own length, plus its dangerous space at the given speed. Owing to the extra braking facilities on a car and trailer, the dangerous space is about the same as for the single car, while the mere length of the trailer represents nearly the whole of the added space required. Therefore, a crowd can be handled more advantageously as well as more cheaply when trailers are used. The single question that is uppermost in the discussion of trailers is that of danger. The judgment of many street railway men in recent years is that the danger to passengers is increased by the presence of the trailer. To this proposition we are rather inclined to dissent, provided the trailer is what a trailer ought to be and not merely a motorless car that is towed. The line of success in trailer design is, in our opinion, in the direction of a construction akin to vestibuled cars, using a specialized trailer for that purpose only. The real danger point is the gap between the motor car and the trailer. Once close up that effectively and the use of the trailer is entirely safe. We have not yet seen, however, any effective way of doing this while using an ordinary car in the role of a trailer.

The modifications necessary for safety go considerably further than merely connecting the cars together, but when the design of trailers as such is deliberately taken up we shall be much surprised if a successful trailer system is not devised. In this particular we should call attention that the legitimate function of a trailer is to increase the capacity of the car unit and not to take the place of a car. If there is one principle more than another that has made for the success of American street railways it is that cars on short headway gather traffic far better than trains on long headway. A car and trailer is no substitute for two cars as a traffic winner, but it helps amazingly during hours of heavy load. Particularly on long lines it comes into play effectively during the rush hours. Do not use it for decreasing the number of car units if you expect it to win friends. It is like the case sometimes found in which a given bit of line may have twelve cars an hour, but unhappily timed so that the actual service is four groups of these cars each on a 15-minute schedule. And then the general manager wonders why the kicks come in. Properly designed and used in their legitimate sphere, the trailer should fill a very useful place in the general economy of a street railway system. One advantage it has that should not be lightly passed over—the reduction of the trippers necessary during the rush hours and during special emergencies. So long as people persist in keeping approximately the same range of working hours, just so long the street railway man will have to figure despairingly on how to handle half a city in two or three hours. The use of trailers is no panacea for such ills, but it may serve as an anodyne. At least it is worth looking into very carefully before it is relegated permanently to oblivion. It served a good purpose once and it may again.

Car Design and Traffic

It is interesting to consider the relation between car design and traffic in the light of the present tendency of some of the later electric roads to purchase expensively finished rolling stock. In some cases cars have been specified for moderate speed suburban or rural service, costing from $9,000 to $10,000 each, a large part of the expense being due to the quality of the interior and exterior finish. A high-speed car for heavy interurban service may easily cost $10,000 if it is built for very fast running, but as a general rule, rolling stock units designed for speeds of 35 m.p.h. or 40 m.p.h. maximum do not reach the foregoing figures of first cost. In some quarters the idea prevails that the purchase of such expensive cars is a hazardous policy for any road which has not been operated long enough to prove its financial soundness, while in other circles the advertising value of such superb cars is considered ample justification for their being supplied.

Looking at the matter broadly, there is no doubt that the public is constantly demanding more improved accommodations upon both steam and electric railways as the schedule speeds increase and cars become heavier. Within the last five years car builders have produced rolling stock units for trolley service which exceed in comfort and appearance many of the cars used on long established steam railroads, and with each new design the tendency is strong to improve upon previous productions. The requirements of different roads vary widely; practice in the direction of reducing fire hazards and withstanding the shocks due to high-speed operation has been influential in preventing the thorough standardization of cars, and the public taste for luxurious equipment has grown by leaps and bounds. There is no doubt that, other things being equal, preference is invariably given to the handsomest cars by the traveling public, and there is no question that the advertising value of a superbly finished, vestibuled, double-trucked piece of rolling stock, with a roomy aisle, large plate-glass observation type windows, comfortable seats and brilliant, diffused interior lighting is exceedingly large.

On the other hand, it would be of doubtful wisdom to equip a large system with a complete outfit of $10,000 rolling stock units unless the financial strength of the enterprise at the start is sufficient to assume such a heavy burden of fixed charges, with the absolute certainty that the road will pay, and pay well. The smaller the road, the fewer are the cars which it requires, so that it would seem better practice to concentrate extra costly finish upon the very small number of cars representing the road than to carry out the idea in the multiplied expense of the larger system. In the latter case, two or three of the more costly cars can frequently be run as limiteds to advantage, leaving the balance of the equipment to be represented by more sober designs. In any case, comfortable riding is of great importance, and liberal dimensions in aisles, seats and vestibules are certain to be appreciated by the discriminating passenger. As for the small road, one would not invariably recommend the purchase of the most costly cars that the manufacturers can produce, by any means, but in general, the motto that what is worth doing at all is worth doing well is applicable. Doubtless local conditions will often be met by a car of moderate cost, but it is certainly a mark of hasty judgment to condemn as extravagant the purchase of the best type of car when the reasons for its selection bid fair to lead to the creation of a desirable volume of traffic. When a road is ultimately to form a link in a through route in competition with a steam line, the importance of attractive rolling stock is not to be gainsaid in its probable influence upon the business to be handled.

A Little More Speed

As last year, the Florida automobile races have given one something to think seriously about. We are used to having records raised quite in the ordinary course of racing events, but to have them projected upward in the fashion of last week is somewhat startling. It makes one stop and consider the probable result had the machines been running on a nice, smooth bit of straight track, well ballasted and laid with 100-lb. rails. As it was, the winner of the fastest mile managed to negotiate the distance at the rate of a little above 128 m.p.h. This performance was, of course, an egregious sprint, with all the steam that could be piled on carried for the necessary half-minute, irrespective of all other consideration. The same machine was signally defeated in a 5-mile run by the gasoline machines, and kept discreetly out of the longer events. But for the sprint it did the trick, and can probably fairly enough be called the fastest thing on wheels. The chances are that during the mile it topped even the tremendous maximum speed reached in the Zossen trials. Even more startling from a practical standpoint was the performance of the big gasoline car that won the 100-mile race at a maintained speed only a shade under 80 m.p.h. This is, we believe, by all odds the fastest run ever made by anything over a similar distance. The nearest approach to it in railway work was a run of 44 miles by the Black Diamond Express nearly nine years ago, at 80 m.p.h. The only higher speed has been made at relatively short distances.

It would be exceedingly interesting to know what actual power was developed in this tremendous performance. The car was rated at 80 hp, and there is no way of getting behind the returns to see what interpretation is put upon this statement. As a rule, gasoline engines are not underrated, especially on stock cars, and the losses in transmission are somewhat heavy. But this was a racer, and there was some glory to be had in adhering to an ultra-conservative rating. However, whatever the horse-power, the results were sufficiently remarkable. At such speed the air resistance was a predominant factor in the work done. Even so, there must have been still a considerable "track" resistance even on the hard-packed sand of the beach, and one turns again to speculate on what the great racer would have done on a good track. We do not altogether approve of some features of the automobile situation, yet, as we have over and over suggested, the value of the automobile in engineering development has been great, and will be greater. It has stimulated the improvement of the internal combustion engine as nothing else could, and the result is being felt not only in self-propelled vehicles, but in central station design. There has been of late a movement toward gasoline and gasoline-electric cars, not only for street work, but for railway service. The experience gained in automobiles will be valuable in traffic vehicles on rails. No mere road can give as favorable traction conditions as a well laid pair of rails, and if a thoroughly practical gasoline railway car appears it will have a very considerable use on lines with relatively light traffic and with moderate grades. The weak point of all internal combustion engines is a certain inflexibility of output that makes them inconvenient for rapid acceleration and for work where there is much stopping and starting. The gasoline-electric combination is a partial but complicated remedy for this difficulty. But even with these limitations there may be found use for the gasoline car presently, since the long roads with light traffic are the very ones in which high acceleration is needless.

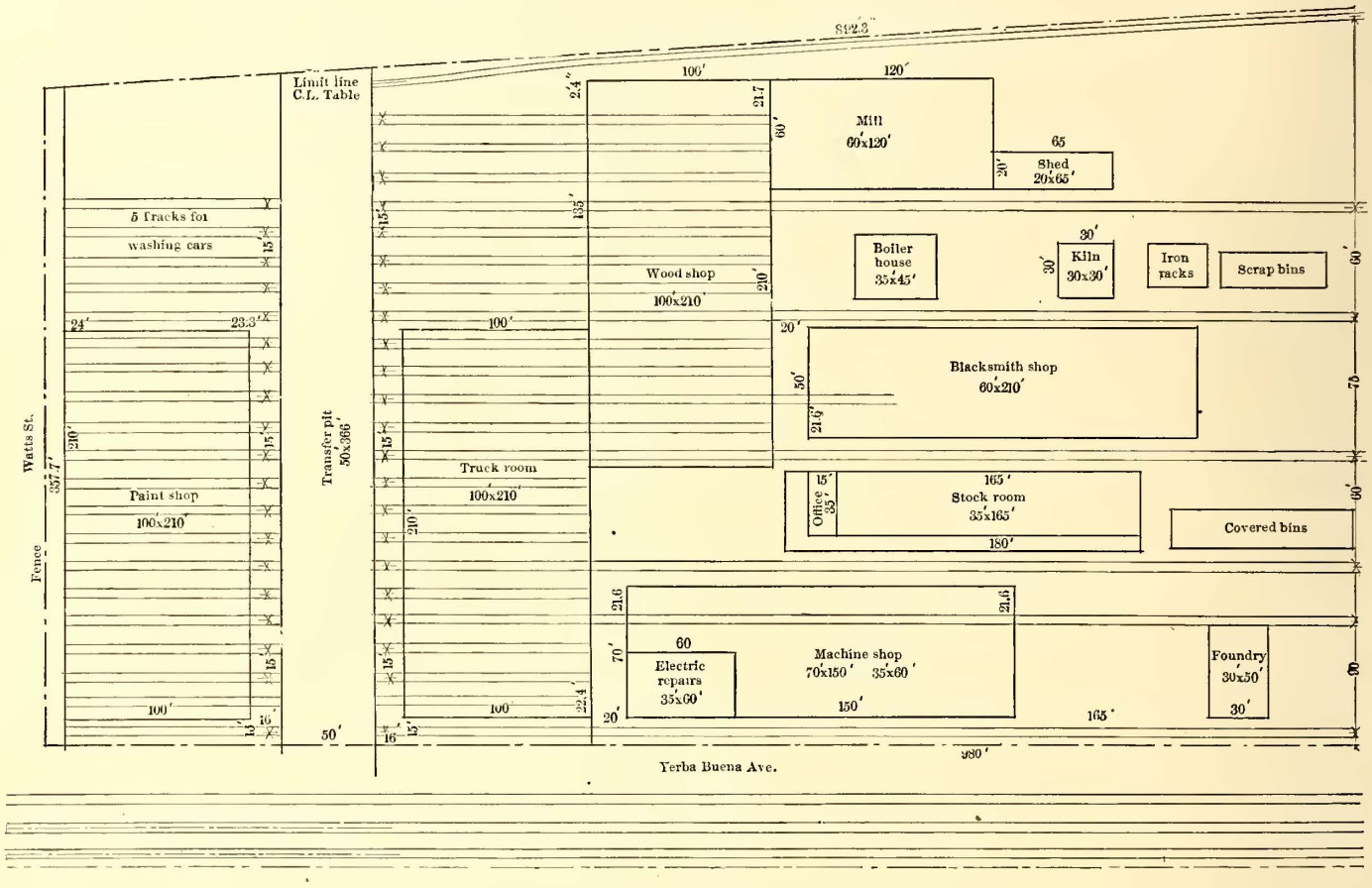
The cost of repairs and renewals in automobiles are, of course, high—so high as at present to constitute a serious failing from a purely commercial standpoint. No machine, however, gets harder usage than an automobile upon ordinary roads, and what is done under these conditions is no fair criterion of what might be done in gasoline motor cars designed for steady work on smooth track. It would be very desirable to have an engine able to work on heavier hydrocarbons than gasoline, owing to the relatively small output of the latter in the petroleum industry. As improvements in carburetting devices are made, this situation will certainly be improved. Another weak point is in the power transmitting devices, and here there is room for the exercise of independent ingenuity. In ordinary automobile practice the transmission is a more difficult problem than it would be on an automobile car, but the conditions of operation are also different, so that the solution advisable in the one case might not be in the other, particularly in view of the difference of speeds of engine. In educating the public to a faster pace the automobile is certainly doing a thorough, if sometimes thankless, job. Certainly any speed that is permissible in a vehicle that uses the highway should be allowed in vehicles that keep to their own appointed track on the same highway. In the automobile business as such there is little of menace to street railways, for the mere question of cost is likely permanently to keep down the number of people who use their machines to avoid riding in the cars. It is only where a fit of overenthusiasm leads to legislation unduly favoring public automobiles on the road as against cars on a track that danger is to be feared. Meanwhile the new developments are not useless, in that they give at least the chance for a new and convenient motive power for cars, not to be used probably as a substitute, but as a complement to those now existing. And races like those just closed, unpractical as they seem at first sight, have a value in technical and popular education. We shall hope to see the records sent upward again next year.

NEW SHOPS OF THE OAKLAND TRACTION CONSOLIDATED AND KEY ROUTE SYSTEMS

The Oakland Traction Consolidated and the San Francisco, Oakland & San Jose Railway, both of Oakland, Cal., are allied companies, with practically identical ownership and management. The former operates 218 miles of city and interurban lines in and between Oakland, Berkeley and Alameda, and connects those cities with San Leandro, Fruitvale and Haywards. Its old shops were located at Elmhurst on the Hayward line, at Temescal on the Berkeley lines, and at Piedmont for the Oakland system.

About two years ago the San Francisco, Oakland & San Jose Railway inaugurated a ferry and electric train service between San Francisco and Oakland, Berkeley and Piedmont, now popularly called the "Key Route" system (see the Street Railway Journal for Jan. 2 and 9, 1904), and the necessity soon became apparent that new shops should be secured in a location which would be central to both systems, and in which all the repair and construction work for both companies could be carried on.

The new power house of the Key Route had been located on Yerba Buena Avenue, on the main Key Route line and within a few yards of the shore of San Francisco Bay. Property adjoining the power house site was then secured for the new shops. The site has a frontage of 980 ft. on Yerba Buena Avenue, as shown on the accompanying plan. The Key Route main line passes on Yerba Buena Avenue, with a station at Hollis Street and another at San Pablo Avenue, one block east. Oakland Traction surface lines on San Pablo Avenue and Hollis Street have direct connection with the shop trackage and connect with all the other lines of the Traction system. About one-third of the property lies in Oakland and two-thirds in Emeryville, the shops deriving their name from the latter.



PLAN OF NEW OAKLAND TRACTION SHOPS

GENERAL VIEW, OAKLAND TRACTION SHOPS

In addition to the connection with the electric railway lines, the shops have direct rail connection with the Southern Pa-

cific and Santa Fe Railroads, and, by means of the 3-mile pier and dock terminal of the Key Route in San Francisco Bay, have deep-water facilities for receiving river, coast and ocean shipments.

Although but four blocks from the bay, the shop site has an elevation ranging from over 24 ft. to 14.75 ft., giving a slope of about 1 ft. in 100 ft., and thus providing good drainage.

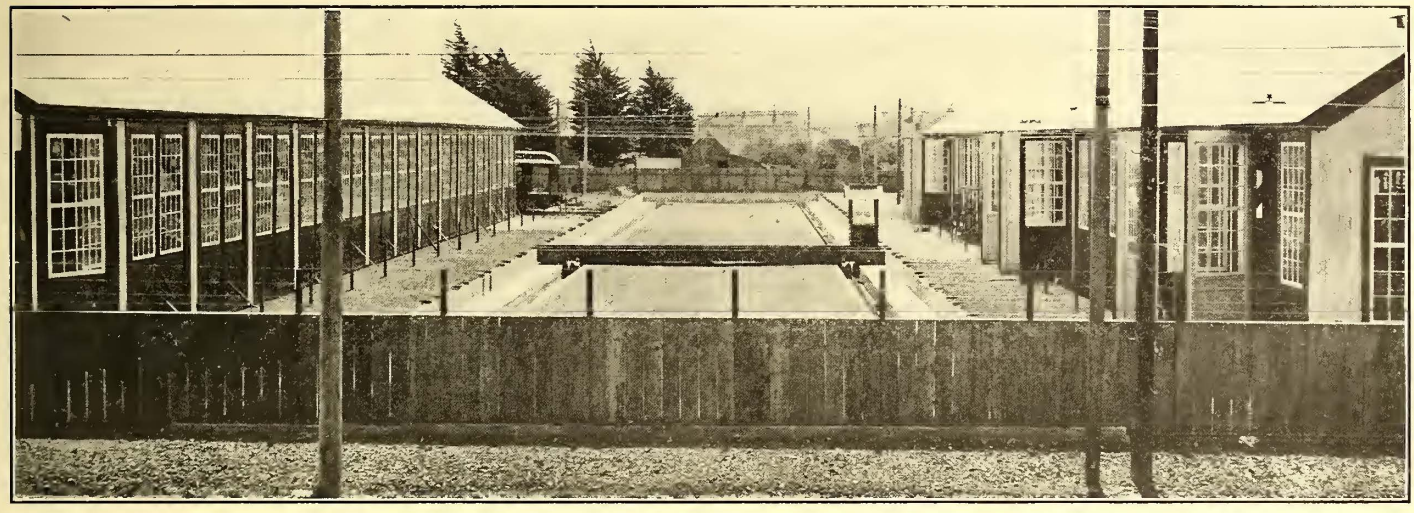
ARRANGEMENT OF BUILDINGS

The shops and grounds have been laid out so as to provide for the greatest amount of work with the least handling of material and expenditure of time, as well as to provide for future extensions of the buildings when their capacities are reached. With this idea in view, the shops were laid out as indicated in the plan. One through track enters from the west, and three other through tracks are laid so they can be extended through to Hollis Street or connected with the one that at present extends outside. A track on the north side connects with the Key Route and Oakland Traction lines on Yerba Buena Avenue.

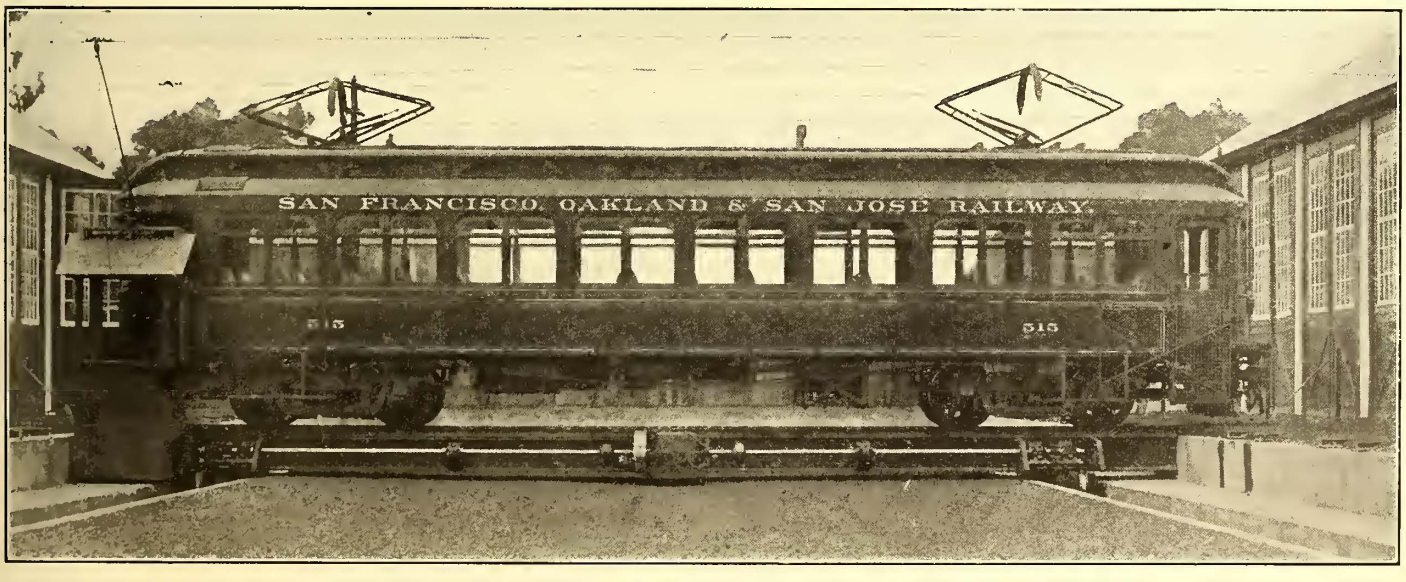
The paint shop is located on the east side of the transfer pit, with the truck room, wood shop and planing mill on the west. Beyond to the west at convenient locations are the forge shop, storeroom, machine shop and foundry. A total of twenty-four tracks are laid across the yards, connecting the buildings, as shown on the plan. The through tracks are laid with 70-lb. A. S. C. E. standard section T-rails, and the other shop tracks with 40-lb. T-rails.

The buildings are all of substantial construction and rest on heavy concrete footings. They were designed for light, strength and convenience, and while their cost of erection was considerably less than would be necessary for structures serving the same purpose in Eastern States, they are entirely serviceable and of sufficient strength and permanency to minimize depreciation.

Heavy mill construction has been adopted throughout, the framing and roof trusses consisting of heavy timbers. Galvanized corrugated sheet iron was used for sheathing and roofs, nothing else being necessary, as the mild climate of the San Francisco Bay region makes thicker or more heat-resistant material unnecessary. A total of 13,955 sheets, or 108,180 linear ft., of sheet iron and 942,000 ft. of lumber was used in the construction of the buildings. As will be noticed from the illustrations, the buildings are very well lighted, most of them having skylights, in addition to side and door windows. A total of 24,581 sq. ft. of glass was used.



TRANSFER PIT, WITH PAINT SHOP ON LEFT AND TRUCK SHOP ON RIGHT, OAKLAND TRACTION COMPANY

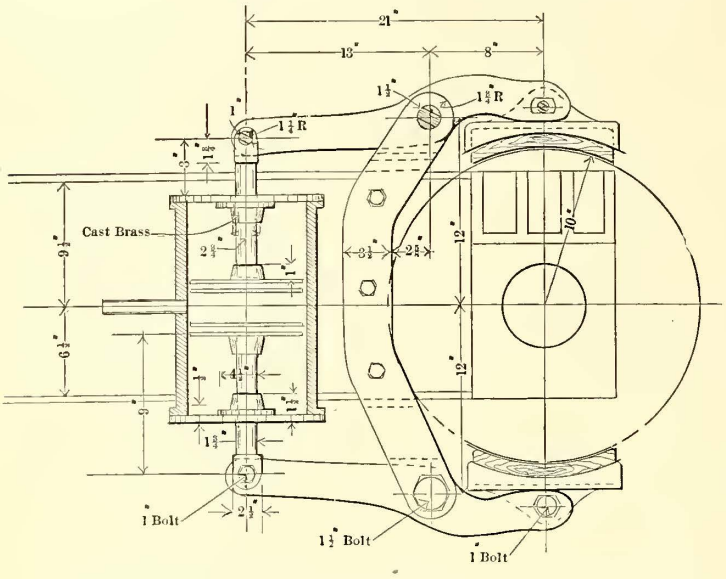


TRANSFER TABLE WITH CAR, OAKLAND TRACTION SHOPS

TRANSFER TABLE

The transfer table runs in a pit 366 ft. long between the paint shop on the east and the truck room and carpenter shop on the west, thus serving all of the twenty-four parallel tracks. The table was designed by the Oakland Traction engineers and

was built in the company's shops. It is of simple construction, but embodies many original ideas in its details. The table is 50 ft. long, the distance between rails of pit being 40 ft. It is designed for a safe load of 80 tons, and will carry a heavily loaded freight car with a deflection of but 3-16 in. at the center. It will handle any of the Key Route cars, the longest of



DETAILS OF BRAKE FOR TRANSFER TABLE, OAKLAND TRACTION SHOPS

which are nearly 60 ft. over all. The two main girders of the table are each built up of two 18-in., 55-lb. I-beams and two 16-in. x ¾-in. steel plates. The truck girders are 10 ft. 10 ins. long, and each is formed of two 12-in. x ½-in. steel plates. The table is cross braced at the center, the braces being extended on one side to form a support for the driving motor. The weight of the entire table is 15.5 tons. Each truck is supported on two 22-in. diameter steel-tired double-flanged wheels mounted with a 10-ft. wheel base.

The table is driven by a GE 800 motor, supported at the center of the table and geared by pinion and gear to a 3-in. cold-rolled steel shaft. At each end the shaft is connected by double pinion and gear to one of the two truck wheels. The table has a speed of 4 m.p.h.

An air brake has been designed for the table which has, for each truck, a double air cylinder 8 ins. in diameter and 15 ins. long, as shown in the sectional diagram on this page. The two pistons operate levers directly connected to shoe brakes, which work on a 20-in. brake wheel. This wheel is mounted on the shaft of one of the truck wheels. The shoes are of oak, made so that they may be easily replaced. Air is supplied from a storage tank on the table that is charged from the air-piping system of the shops. The motor for driving the table and the air-brake system are controlled from a small cab on the west end of the table, power being taken from an overhead trolley running along that side of the pit. Separate trolley wires are carried across the pit for each shop track, so that in running straight across, the trolley arm does not have to be lowered.

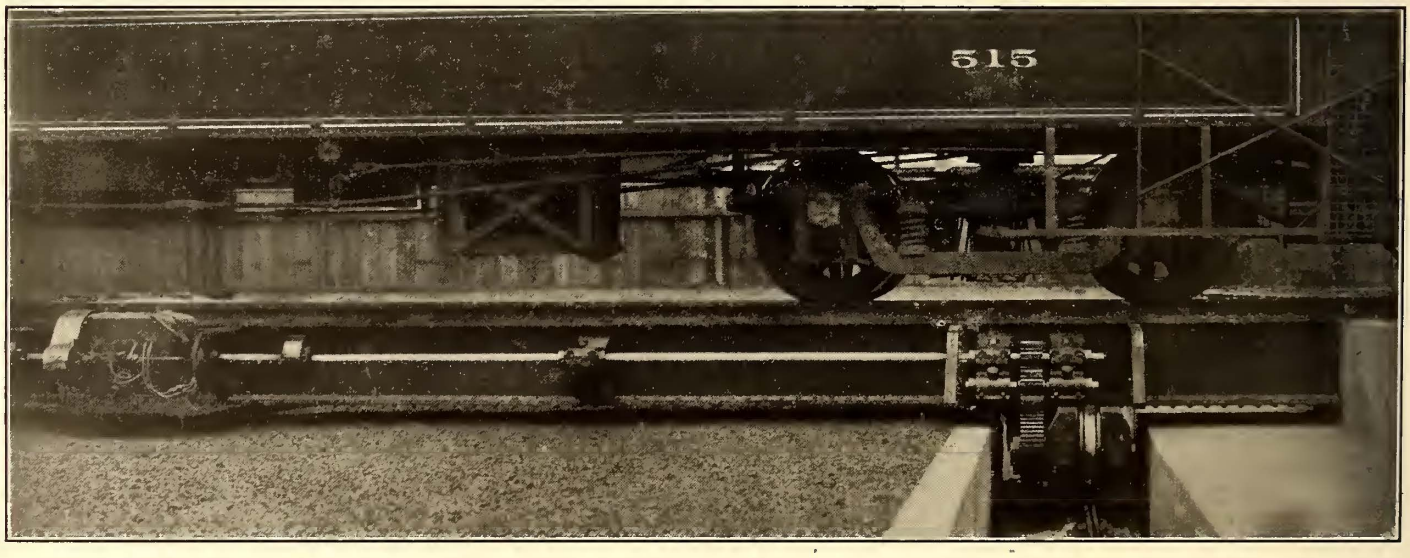
The pit surface is of crushed rock, which is oiled to bind it into a tight surface and to keep out the weeds and water. Ample drainage is provided by connection to the sewer. The track consists of 70-lb. A. S. C. E. standard section T-rails, set in concrete. The track pits are 4 ft. below the surface, and the central part of the main pit 2 ft. below the surface level.

PAINT SHOP

The paint shop, running along the extreme east end of the property, is 210 ft. long x 100 ft. wide. The roof is formed of two bents supported longitudinally through the center by wooden posts. The building is very well lighted, as may be noticed from the illustrations. A total of 4032 sq. ft. of window glass and 1685 sq. ft. of skylights was used.

In the southeast corner of the shop is located the paint stock room, where the paints, oils and supplies for immediate use are kept in drawers, bins and shelves. Along one end are individual lockers for the workmen to store their brushes, tools and personal supplies. A zinc-lined bin is provided for storing waste; a grinder is located on one side of the room, and in the center is a zinc-covered platform for mixing purposes. Adjoining the storeroom are washing trays and a lye vat. Individual clothes lockers are provided in this as well as the other shops for the workmen. They were made in the shops and are ventilated by wire netting.

Fourteen tracks enter the building, each being long enough

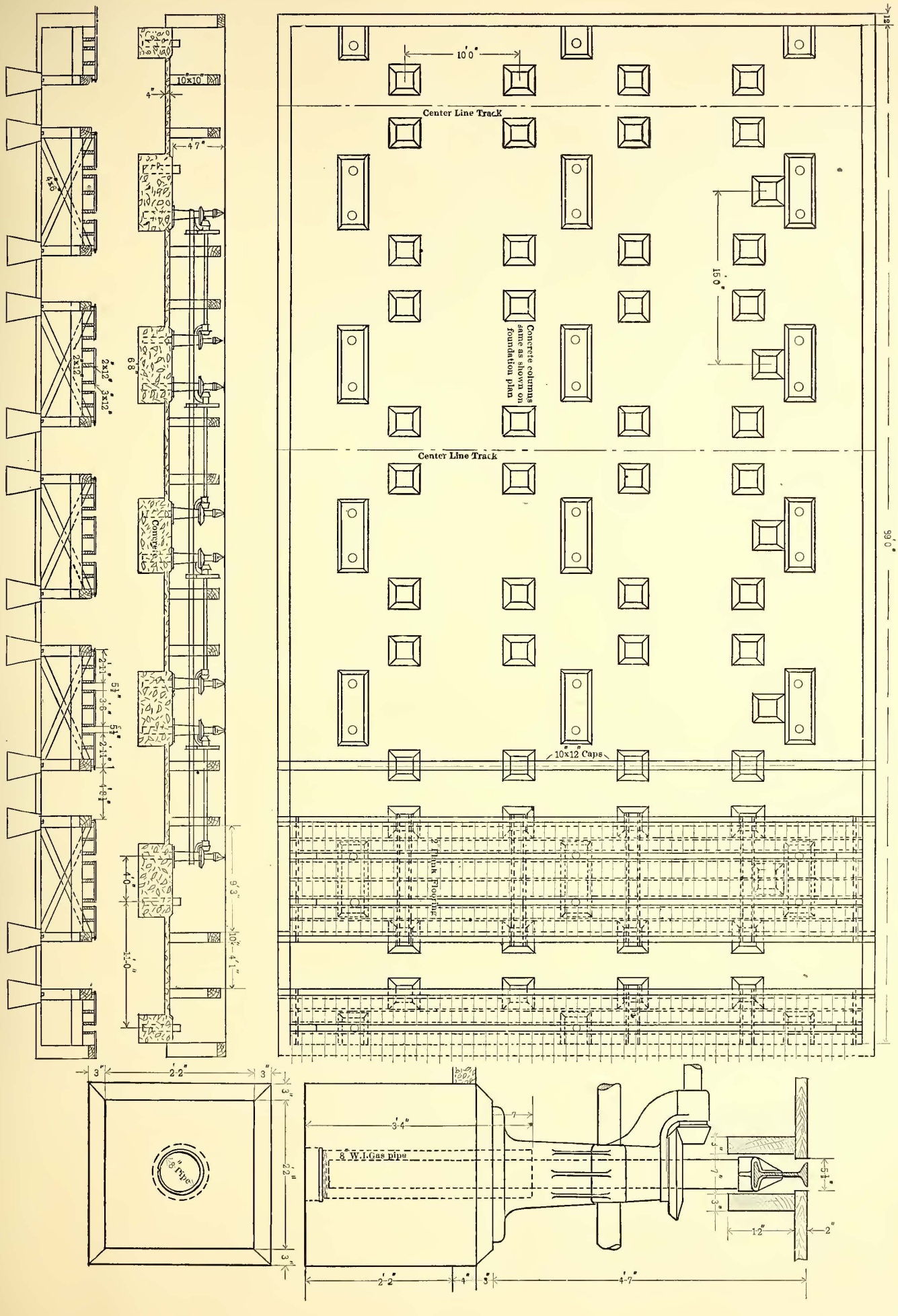


DETAIL OF TRANSFER TABLE, SHOWING MOTOR DRIVE AND GEAR CONNECTION TO DRIVING WHEEL, OAKLAND TRACTION SHOPS

to hold a Key Route car and one of the Oakland Traction cars. At the south end of the paint shop is ample space for extending the building when future requirements demand the room. At present a space 70 ft. x 115 ft. immediately adjoining the building is to be used for car-washing purposes. Four tracks cross this space, which is well ballasted with broken rock and drained to the sewer.

TRUCK ROOM

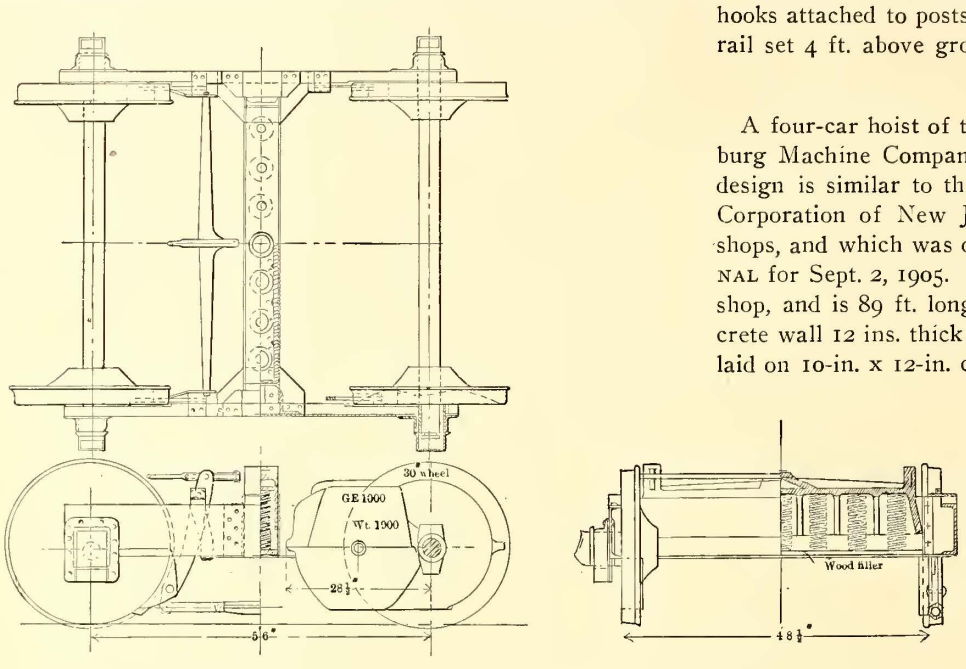
On the west side of the transfer pit and 14 ft. from it is the truck room, a building with two bays, 100 ft. x 210 ft. Fourteen tracks extend across the shop, five of which continue into



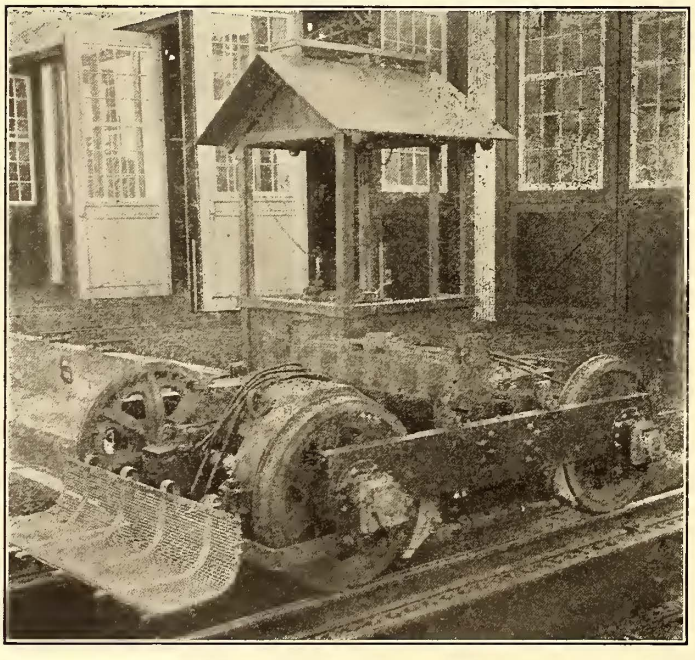
DETAILS OF PITS AND CAR HOISTS IN TRUCK SHOP, OAKLAND TRACTION SHOPS

the wood shop, as shown on the plan. The truck room is well lighted by side windows containing 3600 sq. ft. of glass and by 1685 sq. ft. of skylights.

On the center posts of the shop are mounted six jib cranes with pneumatic hoists. These cranes were designed by the company's engineering department. Five of them have a capacity of 3000 lbs. and a radius of swing of 12 ft., and one has a capacity of 4300 lbs. and a radius of 10 ft. In order to afford proper support for the cranes, the center posts of the west bay of the truck room were put in as single pieces, 8 ins. x 8 ins., 36 ft. long, and carried through to the rafters. The post is reinforced and is double cross braced. The headroom in the shop is 17 ft. 4 ins. The rafters have wrought-iron caps for tie-rods, and the bents are cross braced with tie-rods centering in bull-rings.



DETAILS OF MOTOR TRUCK, CLASS I, OAKLAND TRACTION LINES



CLASS I TRUCK, USED ON OAKLAND TRACTION CONSOLIDATED LINES

The doors of the truck room and paint shop opening onto the transfer pit are double, each single door being 6 ft. wide and 16 ft. 8 ins. high. Each has a double sash of twenty-four panes of 12-in. x 17-in., 16-oz. glass, thus affording very good light when closed. The doors are hung on three sets of wrought-iron hinges. The door hinge piece is a 2½-in. x ⅜-in. strap, 5 ft. 3¼ ins. long, with eyes fitting over ¾-in. pins on the stationary piece. The latter is 3 ft. 3½ ins. long, and has pins at both ends for adjoining doors. Each door is held open by hooks attached to posts, the latter consisting of pieces of 40-lb. rail set 4 ft. above ground and neatly aligned.

CAR HOIST

A four-car hoist of the new type manufactured by the Pittsburg Machine Company is installed in the truck room. The design is similar to that of the one which the Public Service Corporation of New Jersey has installed in its Plank Road shops, and which was described in the STREET RAILWAY JOURNAL for Sept. 2, 1905. The pit is located in the east bay of the shop, and is 89 ft. long inside and 50 ft. wide. It has a concrete wall 12 ins. thick and is 4 ft. 7 ins. deep. The tracks are laid on 10-in. x 12-in. caps, which rest on 10-in. x 10-in. posts, that in turn are supported on concrete footings. The caps are cross braced between tracks by 4-in. x 6-in. pieces. A plank flooring is laid between the tracks on 12-in. stringers, which in turn rest on 12-in. cross beams. This construction leaves the space between the rails of each of the six tracks crossing the pit open and free for the workmen.

The hoist, as shown in the drawings, is formed of two 9-in. I-beams, 45 ft. long, for each track. Each beam carries one side of the car, and is supported on three 7-in. steel jack screws that are raised and lowered through cast-steel bevel gears and pinions. The pinions on opposite jacks are mounted on 10-ft. shafts extending across the pit, three for each hoist. These short shafts are in turn driven through straight gearing from a motor-driven line shaft running the length of the pit. Each jack screw operates in a case consisting of an 8-in. wrought-iron gas pipe, 3 ft. 4 ins. long, set 2 ft. 6 ins. in the concrete footing. The case is filled with lubricating oil. Automatic limit switches are provided to stop the hoist at its maximum height above the floor. The hoist I-beams extend the width of the pit, and when not in use rest in 5½-in. slots, flush with the floor. Each hoist is arranged with a clutch so it can be thrown in or out of gear. This hoist is capable of raising the heaviest Key Route cars, and does the work quickly and efficiently.

PLANING MILL, OAKLAND TRACTION SHOPS

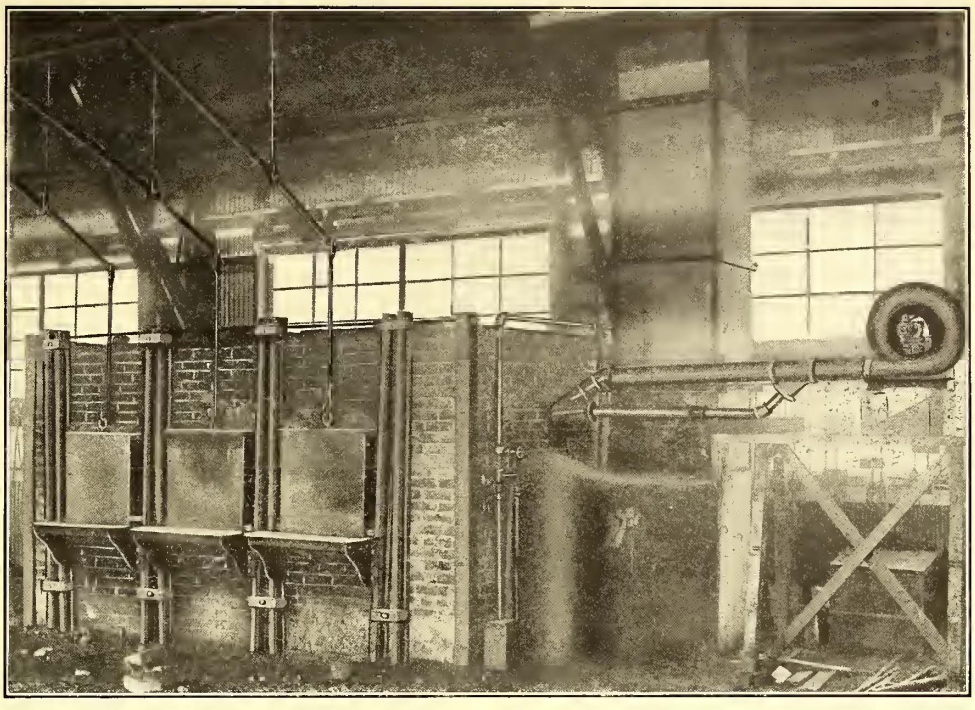
CLASS I TRUCK

The type of truck that has been adopted for the cars of the Oakland Traction Consolidated has several interesting features.

It is known as the Class I truck by reason of its general resemblance to that letter, and was designed a few years ago by J. Q. Brown, assistant general manager and engineer of the company. Although not fully meeting with the favor of the officers of the road at first, it has proved by its merits to be the type of truck best suited for the conditions of the local cars, and is now fast superseding all other forms of trucks. In fact, no trucks have been purchased since the company began to build the Class I truck. About 200 are now in use, and they are being installed under other cars as fast as conditions warrant.

The chief features of construction of the truck, as may be noted from the accompanying illustration and drawings, are its simple construction, the facilities for its ready repair and the ease of getting at the journal boxes for oiling and inspection. It is built up of riveted steel channels, plates and angles. For the cross beam 12-in. channels were originally used, with the top flange cut off, but now 12-in. x ⅜-in. plates, 5 ft. 6½ ins. long, are used, with 3-in. x ½-in. angles at the bottom. For the sides 10-in. 25-lb. channels, 6 ft. 5 ins. long, are employed. The truck has 30-in. wheels, with a wheel base of 5 ft. 6 ins., with inside-hung brakes. The motors are also inside hung.

This truck is not expensive to build; has outside bearing boxes, which can be easily reached; is compact and easy riding. Its chief merit, however, lies in its low maintenance. In the four years that the company has used this type of truck, the cost of repairs has been less than on any of the other types in use; in fact, there is seldom more than one or two of these trucks in the shop for repairs at any one time.



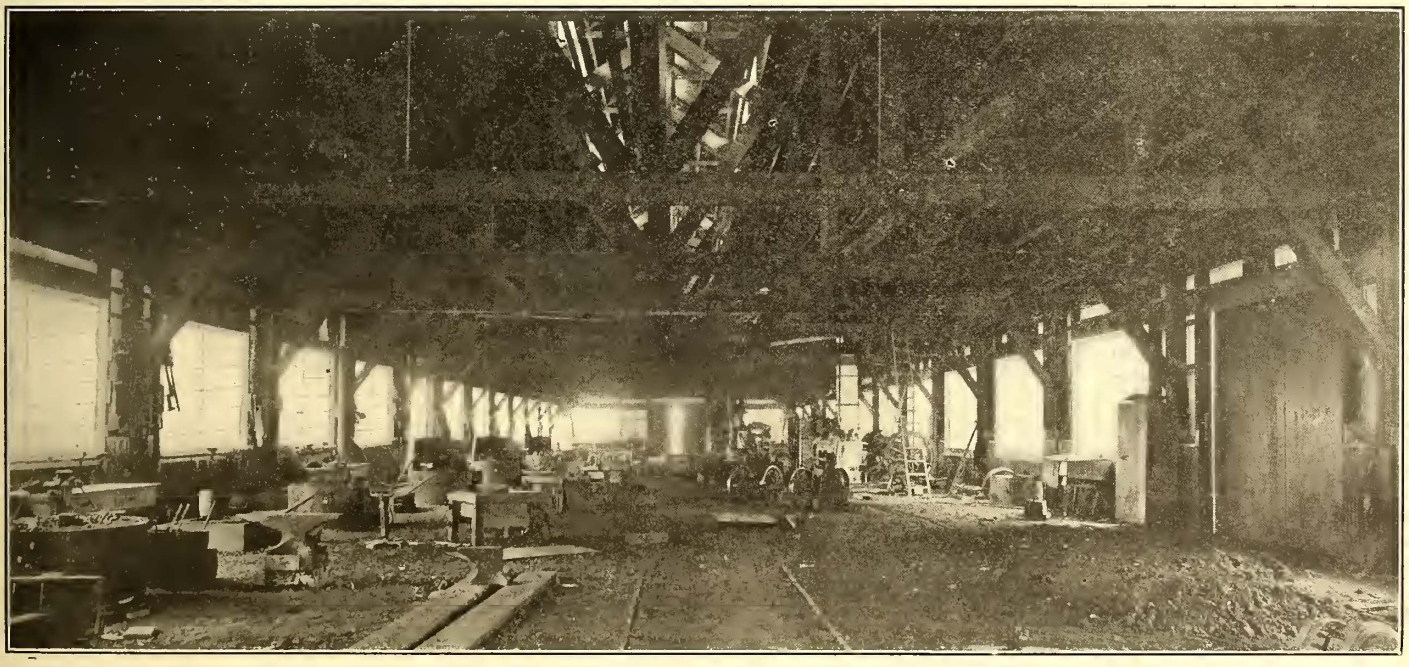
OIL FURNACE IN FORGE SHOP, OAKLAND TRACTION SHOPS

WOOD SHOP

The wood or carpenter shop is built in between the truck room and mill, as shown on the plan. It is 210 ft. x 100 ft., and has thirteen tracks connecting with the transfer pit, five of which pass through the truck room. This arrangement is convenient for transferring cars directly to and from the car hoist without their passing out doors to the transfer table. In the wood shop is done all the body construction and bench work, also the necessary woodwork for the steamers, buildings, etc.

WOOD MILL

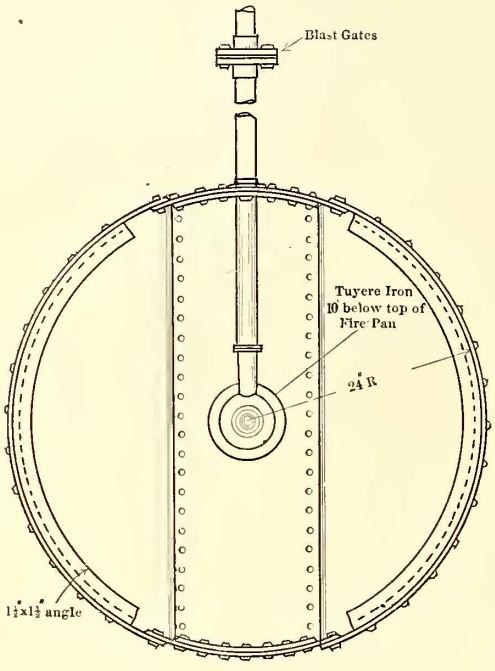
Immediately adjoining the carpenter shop and opening from it in an L on the southwest corner is the wood mill, a room 60 ft. wide and 120 ft. long. A feature of the north wall construction is doors which slide up to open. They are arranged in this manner to save room and to permit handling of material from the track outside directly into the shop. When open, the doors shut off the light from the windows above, but let an equal amount through the door opening. The window sash above the door is 10 ft. wide and 7 ft. high, the door being of the same width and giving an opening 7 ft. 9 ins. high.

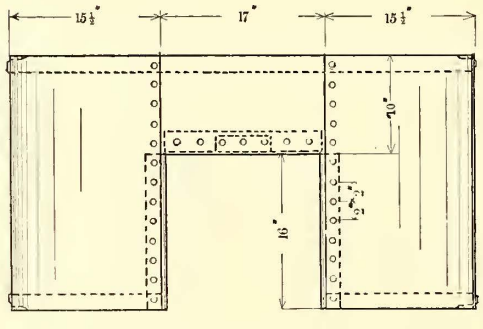


PARTIALLY EQUIPPED FORGE SHOP, SHOWING FORGES AT LEFT, OAKLAND TRACTION SHOPS

The wood mill is operated by two 50-hp, 500-volt motors, belted to line shafts. The floor of the shop is raised above that of the carpenter shop, and all the shafting and belting is placed beneath the floor. This arrangement gives a clear work room, and not only eliminates the danger from belting, but protects the shafts and motors from dust, and makes it easier to handle long pieces of lumber.

The equipment of the mill is very complete, and comprises all the woodworking machines necessary for the repair and construction of cars. Included in the equipment are a Fay & Egan double panel raiser, a patent foot miterer, an automatic sash and door clamp, an elbow power sander with 7-ft. swing, a 36-in. carborundum planer-knife grinder, a Greaves & Klusman 16-in. joiner with 8-ft. table, a four-head six-roller Northwestern planer and matcher, an 8-in. x 26-in. American planer and matcher, a Baker combined rip and cut-off saw, a Powers tenoning machine, a 10-in. Porter double shaper, a 42-in. Hall & Brown band resaw, an 18-in. Fisher automatic cut-off saw, a Fay & Egan 40-in. cut-off saw, an 8-in. joiner, a 12-in. rip saw, a 32-in. band saw, a 7-in. Hall & Brown sticker, a 24-in. planer, a Smith mortising machine, a three-spindle American vertical borer, a Porter 26-in. pattern maker's lathe, a 30-in. Hall & Brown swing cut-off saw and a single-post boring machine. There is also a complete equipment of mill trucks for handling work. A kiln of suitable capacity is to be built west of the wood mill.



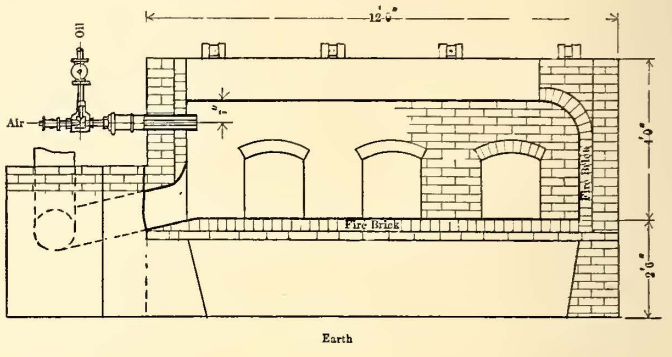


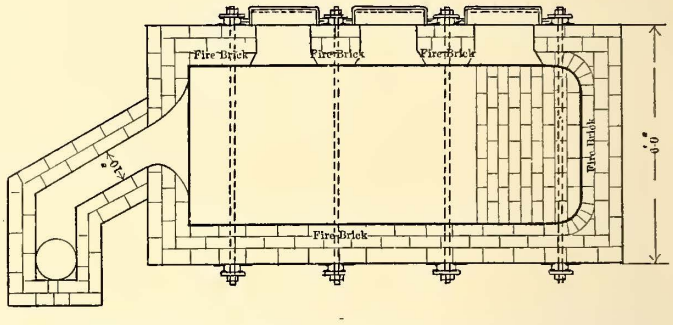
PLAN AND SECTIONAL ELEVATION OF BLACKSMITH FORGE, OAKLAND TRACTION SHOPS

FORGE SHOP

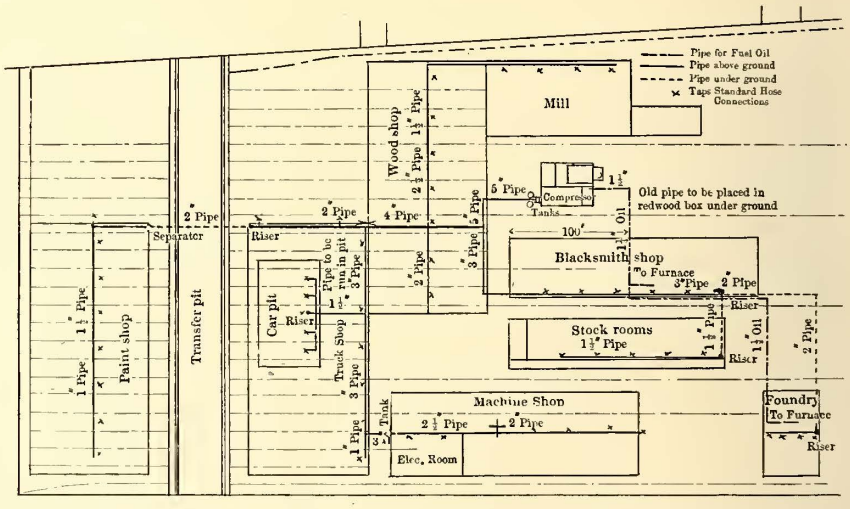
The forge shop is a separate building, 60 ft. x 210 ft. in size, and is located at right angles to the truck and carpenter shops. Ample light is furnished by 1512 sq. ft. of glass. A ventilator on the ridge of the roof permits the escape of the gases and smoke.

The equipment consists of nine forges of special design—





PLAN AND SECTION OF SIDE ELEVATION OF OIL FURNACE IN BLACKSMITH SHOP, OAKLAND TRACTION SHOPS



PLAN SHOWING AIR AND OIL PIPING IN OAKLAND TRACTION SHOPS

FORGE SHOP

The forge shop is a separate building, 60 ft. x 210 ft. in size, and is located at right angles to the truck and carpenter shops. Ample light is furnished by 1512 sq. ft. of glass. A ventilator on the ridge of the roof permits the escape of the gases and smoke.

The equipment consists of nine forges of special design—

PLAN AND SECTION OF SIDE ELEVATION OF OIL FURNACE IN BLACKSMITH SHOP, OAKLAND TRACTION SHOPS

PLAN SHOWING AIR AND OIL PIPING IN OAKLAND TRACTION SHOPS

space being provided for the addition of as many more—a three-door oil furnace, a second furnace being installed, an 800-lb. steam hammer, a 2000-lb. steam hammer, a pair of power shears, a combined punch and shear, an oil rivet furnace, an oil-forging furnace, a pneumatic riveter, a No. 7 Ajax bulldozer and a carborundum car-wheel grinder. All the special track work is done in this shop, the work being laid out in the west end of the building.

The forges are spaced 20 ft. center to center along the south side of the shop, and are connected with the motor-driven blower by a pipe laid underground. This pipe varies in diameter from 14 ins. to 8 ins., and connects with the individual forges through 45-deg. reducing branches. The forges are 48 ins. in diameter, and are built up of 3-16-in. sheet iron and

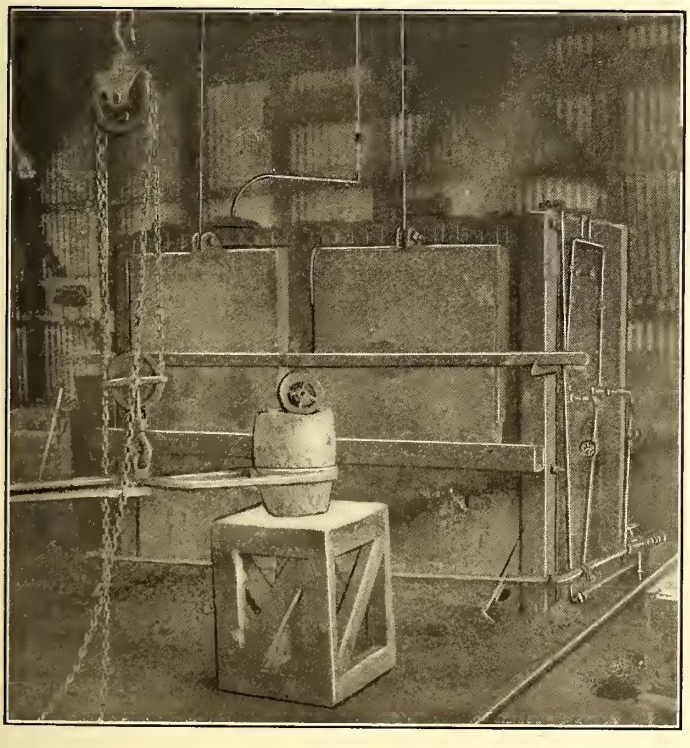
1½-in. x 1½-in. angles. The fire-box is 17 ins. wide, and the tuyere iron is located 10 ins. below the top of the fire-pan. One of the accompanying views shows the forging furnace recently installed.

OIL FURNACE

The oil furnace used for forging purposes is of large size and of a design not usually found in electric railway shops. Its general details of construction are shown in the accompanying illustration and drawings. In general dimensions it is 12 ft. long, 6 ft. wide and 6 ft. 6 ins. high above the floor line. It is built of brick, with the floor of the furnace 2 ft. 6 ins. above the ground floor of the shop. The brick walls are carried down to the ground, and the space beneath the furnace floor is filled in with earth. The interior is 4 ft. wide, 10 ft. long and 3 ft. 7½ ins. high to the center of the arch. It is lined with fire-brick. There are three openings, each 18 ins. wide and 20 ins. high. The doors are 23 ins. wide, 25 ins. high and 5 ins. deep. They are of cast iron and lined with fire-brick. At the sides of the doors are attached 3-in. iron rollers which serve to guide the door when raised and lowered, between vertical 40-lb. T-rails serving as guides. Counterbalancing weights are connected to the doors by means of levers which lead to overhead handles 10 ft. in front of the doors.

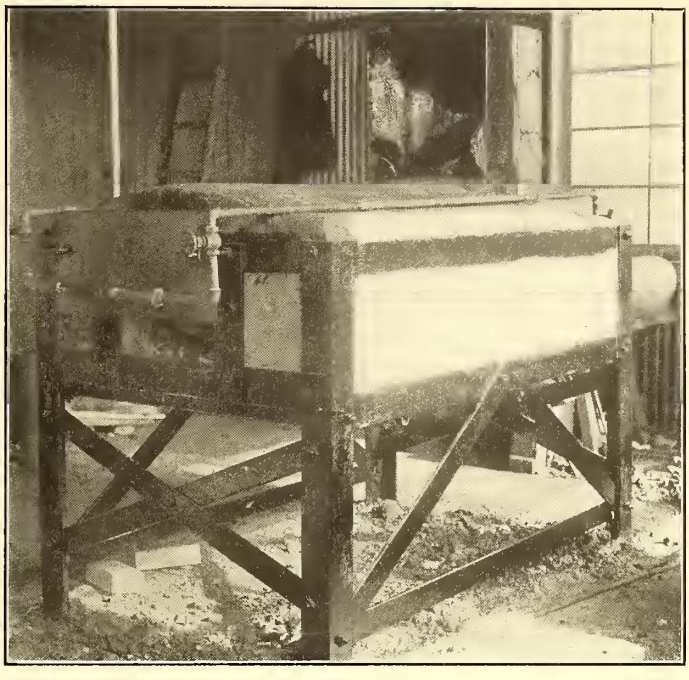
As fuel oil is much cheaper than coal in California, its use for a furnace of this character was, of course, predetermined. Additional reasons for its use were the favorable experiences of the large steam railroad companies and manufacturers on the coast with oil furnaces. Oil has not only proved to be the cheaper fuel, as well as the most convenient to handle, but uniformly better results have been obtained when the metal has been heated with oil.

The type of burner is one that has been adopted by some of the largest metal workers on the coast, and although simple in



OIL FURNACE IN BRASS FOUNDRY, OAKLAND TRACTION SHOPS

construction has proved to be very well adapted for the work. The blast is delivered to the burner by a separate motor-driven blower through a 4-in. pipe, a blast gate affording means for regulating the blast. Air for the atomizer is taken from the blast pipe through a 1-in. pipe with a 45-deg. Y branch. The oil supply is carried through a 1-in. pipe, connecting with the atomizer at right angles to the air pipe. Short lengths of 1-in. brass pipe with conical ends are inserted in both pipes, the blast striking the oil at right angles and thoroughly atomizing it. The burner proper consists of a 4-in. blast pipe, with a 1-in. wrought-iron pipe centered in it, the blast serving to carry the flame over the top of the furnace and back onto the metal to be



OIL FURNACE FOR LIGHT FORGING WORK, OAKLAND TRACTION SHOPS

heated. The smaller pipe passes through a brass bushing and terminates 1½ ins. from the end of the 4-in. pipe, which in turn projects 4 ins. inside the furnace wall. The temperature in the furnace with this type of burner can be regulated as required. A 4-in. car axle can be brought to a white heat in eight to ten minutes.

MACHINE SHOP

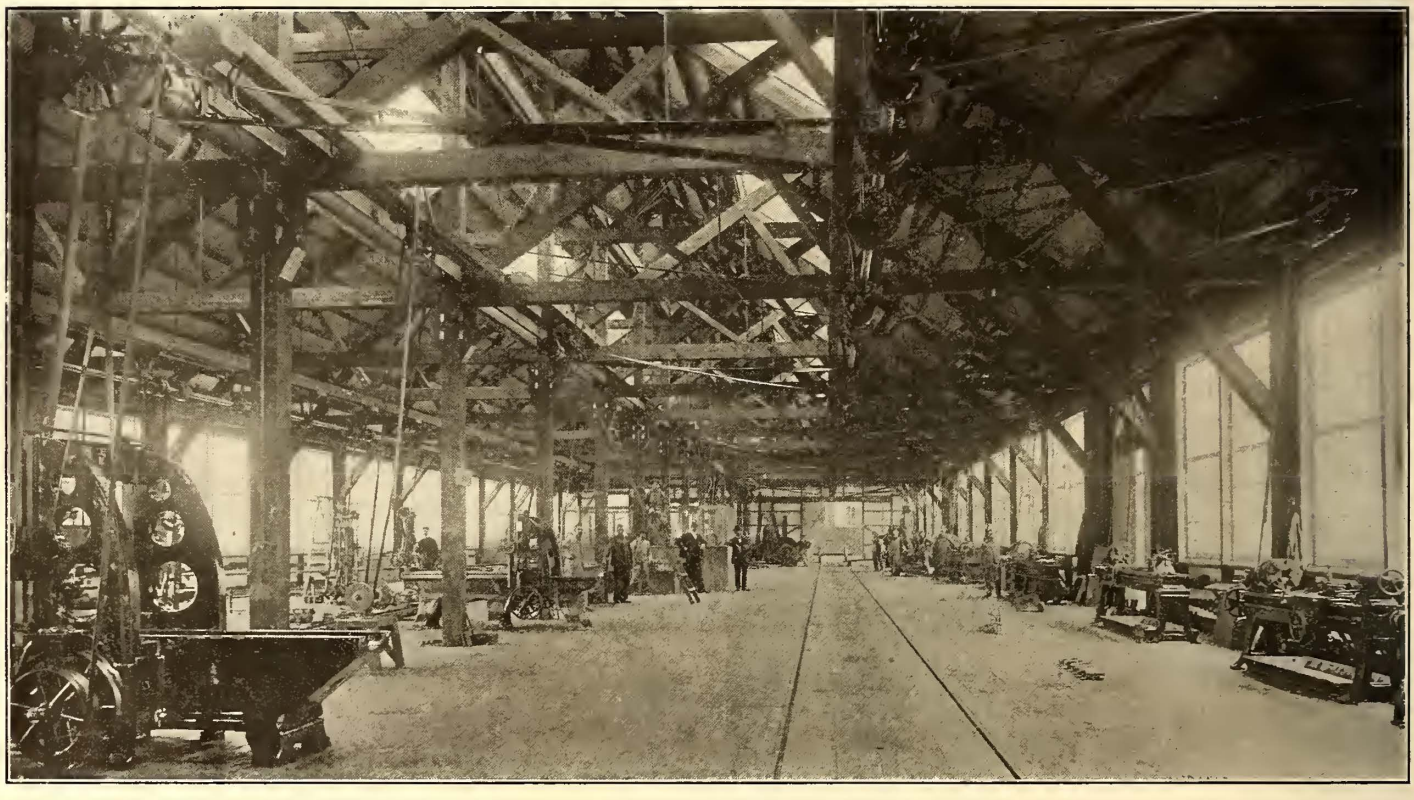
The machine shop, located on the north side of the grounds, is 70 ft. wide and 210 ft. long. In the northeast corner is an armature shop 35 ft. x 60 ft. The building is heavily trussed with double cross braces as in the truck room, so as to provide suitable support for the cranes and line shafting. The floor is double, and consists of 3-in. and 1⅛-in. tongue and grooved Oregon pine flooring, laid on 4-in. x 6-in. redwood stringers which rest on concrete walls. As with the other buildings, this shop is exceedingly well lighted, having 2916 sq. ft. of glass in the windows and 1485 sq. ft. of roof lights.

All the machinery is driven from two 3-in. line shafts, 200 ft. in length, that receive power through a 4-in. jack shaft from a 120-kw T-H. multipolar generator, operating as a motor. This motor is located in the east end of the shop, near the point of heaviest load. The line shafting method of operation was selected as being the best adapted for the requirements of the shop, especially in view of the fact that the company already had the generator on hand.

A special switchboard was built to serve as a starting panel. It was constructed on an iron frame and contains a circuit breaker, ammeter, special starting switch and shunt-field rheostat. For a starting box an old car rheostat was brought into service, the spider being cut out and terminal plates substituted for the contact plates. The starting switch is arranged with four points so that the four sections of the rheostat can be thrown into circuit as needed to build up the current in starting.

The equipment of the machine shop comprises all the tools and machines necessary for the repair and construction work for the two railway systems, including that for the power

houses and for the ferry boats of the Key Route. The heavier machines are located in the southeast corner, where they are served by a track running in from the truck shop. A Bement-Niles axle lathe is placed near the door. It is the practice of the company to roll all axle journals in order to close the grain of the metal and increase their wearing qualities. Next is a hydraulic wheel press, with special fittings, and opposite is a 42-in. Niles steel-tired car-wheel lathe. The company turns all its Key Route wheels on this lathe. A 42-in. Niles car-wheel boring machine is also provided. The remaining equipment in this shop includes eight machine lathes, two planers, six drill presses, two shapers, two bolt cutters, a pipe-cutting and threading machine, a 24-in. cold metal saw, a special Morse twist-drill grinder and three carborundum grinding and polishing sets. Each of the lathes is served by a jib crane with pneumatic hoist. Tires are heated for replacing on car wheels by means of gas flames issuing from holes in circular pipe that surrounds the tires. A tire can be put on in this manner in from ten to thirteen minutes. The gas is generated in a tank from gasoline with the aid of air at about 40 lbs. pressure. A similar gas generator is used for burning off paint. In the center of the shop is a tool room, all tools being issued on a check system.



MACHINE SHOP, OAKLAND TRACTION SHOPS

All the construction work on the diamond-shaped trolleys used on the Key Route cars is done in this shop. The illustration on the opposite page shows several of these trolleys under construction. Some of the brass contact rollers can be noted in the foreground.

ARMATURE ROOM

The armature room in the northeast corner of the machine shop is arranged for making all armature, field coil and general electrical repairs. It is to be served by a crane with air hoist, traveling the length of the room. The shop is equipped with a large electric oven, a special field-winding machine, an armature lathe, electric testing circuits and the other tools necessary for a shop of this kind.

The electric oven is 3 ft. 7⅛ ins. high, in the clear, and 4 ft. deep. It is divided into three compartments, and is 14 ft. long over all. The rear and side walls are built of two layers of fire-brick. The top of the oven consists of 3½-in. T-rails, laid across the oven on 14-in. centers and filled in with 12-in. x 12-in. x 2-in. fire tile, topped with concrete. There are three sets of double doors, built up of plates and angles on channel-iron frames. The doors are held shut by means of suitable catches. An opening 3 ft. 10 ins. wide is provided for each section when the doors are open. A track with a 3-ft. gage enters each oven so that trucks with heavy armatures may be rolled in on trucks.

The electric heaters for the oven are two in number, and are built in vertically between the sections. Each heater consists of seven 1-in. gas pipes, 3 ft. 9 ins. long, covered with two layers of 1-16-in. sheet asbestos, shellaced and wound with No. 21 annealed iron wire, seven turns to the inch. The wire is 0.032 in. in diameter and is tinned. The rods or pipes are spaced 6 ins. apart and are held by ⅜-in. special wrought-iron clamps, fastened to the tie-rods of the furnace at the top and bottom. The clamps are bolted together by ⅜-in. and 1½-in. bolts.

Current for the heaters is taken from the trolley supply through a 30-amp. fuse to a snap switch and to a double-pole double-throw knife switch, by means of which the current can be sent through the two heaters in series or in parallel, and thence to ground. A current of 14 amps. is required for operating the two heaters in parallel. An armature can be baked thoroughly in the oven in about 24 hours.

BRASS FOUNDRY

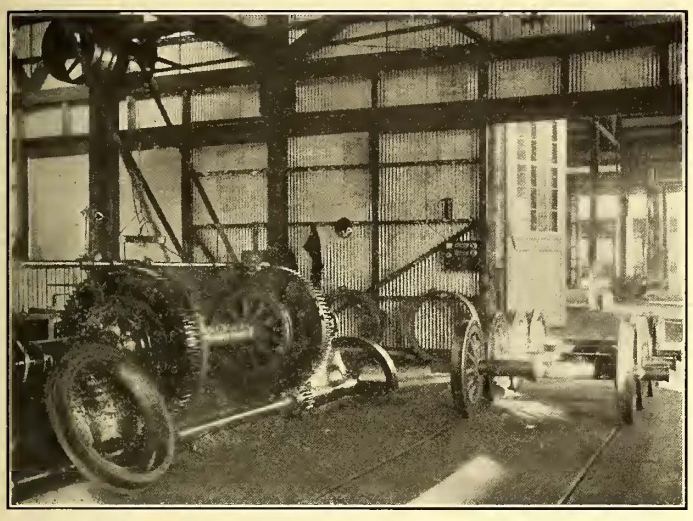
To the west of the machine shop is located the brass foundry in a separate building 30 ft. x 50 ft. In this building are made all the brass and bronze castings used by the Oakland Traction Consolidated and the San Francisco, Oakland & San Jose Railway. It is equipped with a double-door oil furnace, benches, bins, shelves and the necessary foundry tools. A revolving brass furnace is soon to be constructed in the foundry.

The brass furnace has outside dimensions of 7 ft. 3 ins. wide, 3 ft. 3 ins. deep, and 5 ft. 6 ins. high. It is built of red brick walls, with the bottom of the furnace 30 ins. above the floor, the space between being filled with earth rammed in. The furnace is lined with fire-brick and has two arches. Angle

irons at the corners with cross bolts serve as a structural frame work. Crude oil is burnt as fuel, the compressed air from the shop system being used for the blast. The fnrnace has a capacity of 350 lbs. of metal melted in an hour.

STOREROOM

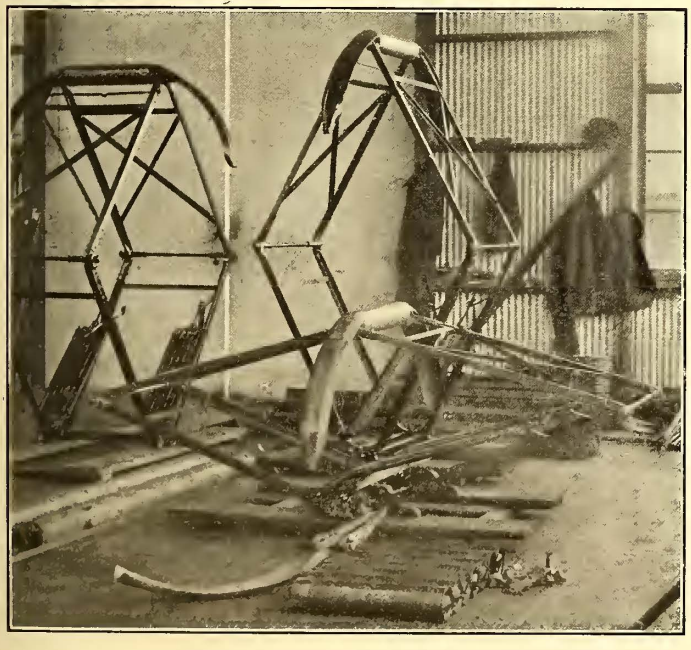
Located between the forge and machine shops and convenient to all the buildings is the storeroom. It is 35 ft. wide and 165 ft. long, and has a second floor lighted by skylights. At



CORNER OF MACHINE SHOP, SHOWING WHEEL LATHE, OAKLAND TRACTION SHOPS

the east end of the building are the offices of the master mechanic. The location places this official practically in the center of the entire system of shops, so that he can easily supervise the work in all departments. This arrangement has been found to work out better than having the offices at the entrance to the grounds or at any point on the edge of the shops.

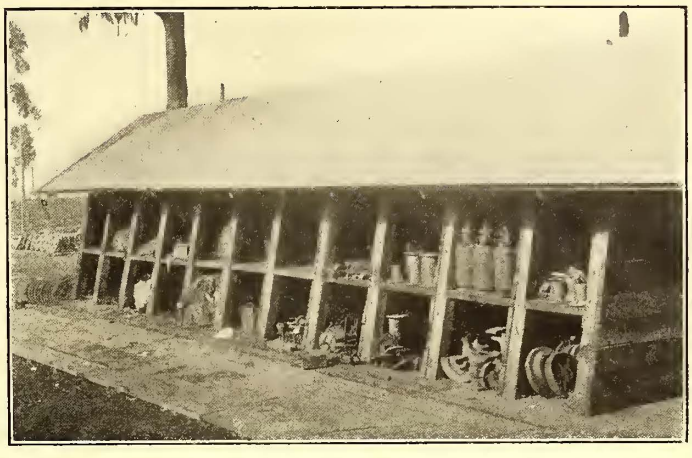
The first floor of the stock room is raised to the level of a flat car, and along the north side is an 8-ft. platform to facilitate unloading from the cars. Inside there are provided some 3600 bins of different sizes and 480 drawers for various over-



DIAMOND TROLLEYS UNDER CONSTRUCTION, BRASS CONTACT ROLLER ON FLOOR IN FOREGROUND, OAKLAND TRACTION SHOPS

head track and shop supplies. There are also a large glass rack, a case containing shelves and drawers for canvas, cloth and curtains, a case for fiber, asbestos and stencil board, a large broom rack and other divisions for necessary stores. The bins for screws are painted yellow for brass, blue for blue-headed and white for plain iron screws, to facilitate finding the ones wanted. An elevator serves to carry the stores between the first and second floors. In the center of the building is located the storekeeper's office. Goods are only delivered on requisition signed by shop foremen.

For heavy stores outside bins and racks are provided. These include a large covered rack open at the ends for bar iron and steel, covered bins for scrap material and sheds for lumber storage. Ties and rails at present are stored in the yard of the

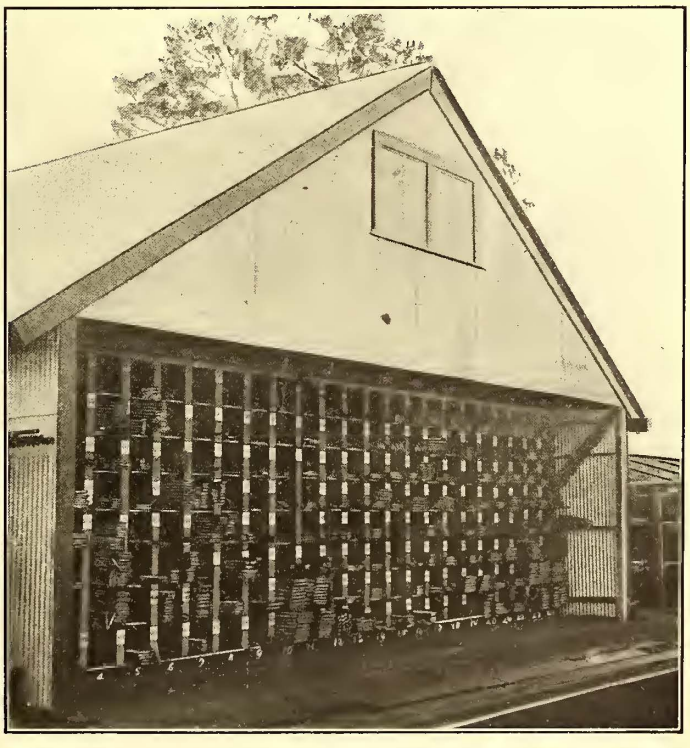


COVERED STORAGE BINS FOR HEAVY SUPPLIES, OAKLAND TRACTION SHOPS

power house, where ample room is provided. Covered bins are used to store heavy metal supplies and miscellaneous articles that would otherwise be scattered about the yards.

RAIL HOIST

A device which has proved to be of great service to the company is a rail hoist or loading machine. The hoist was designed

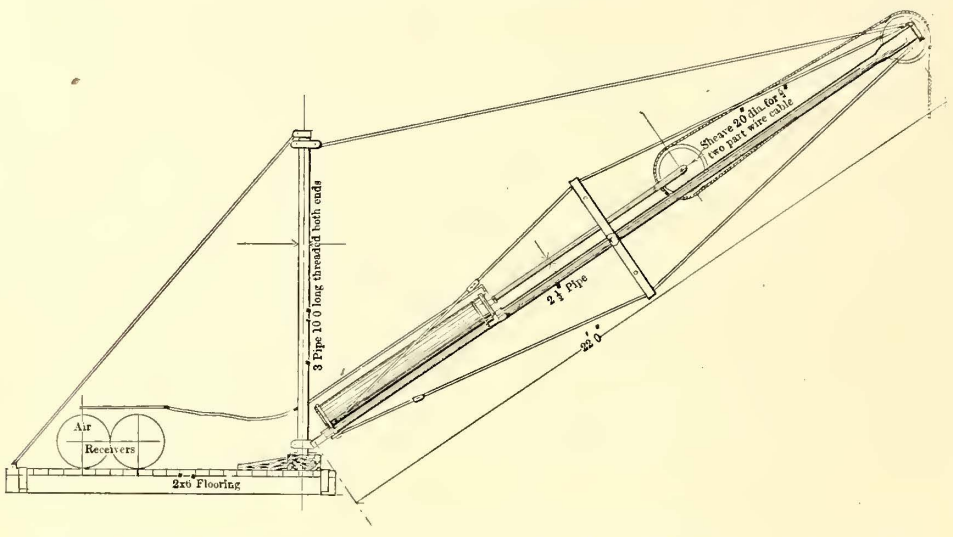


COVERED RACKS FOR STORING IRON AND STEEL STOCK, OAKLAND TRACTION SHOPS

by the company's engineer and built in the shops. It consists of a 23-ft. jib crane, with pneumatic hoist, mounted on a platform on one end of a flat car. It is of built-up construction, the vertical mast consisting of a 3-in. pipe, 10 ft long, secured by

rear braces and supporting the jib by a ¾-in. rod, 18 ft. 6 ins. long. The jib consists of a 2½-in. pipe, 22 ft. 8 ins. long, cross braced at the center and guyed by four ⅝-in. rods provided with turn buckles.

An air cylinder, mounted on the jib by wrought-iron bands, consists of a 7-in. pipe, 6 ft. 6 ins. long, bored out for the piston head. The air piston is a 1½-in. cold-rolled steel shaft, and bears at its outer end a 20-in. sheave, adapted for a two-part wire cable. The cable, the end of which is secured to the outer



DETAILS OF RAIL HOIST FOR UNLOADING RAILS, OAKLAND TRACTION SHOPS

end of the jib, passes over this moving sheave, and also a 17-in. sheave fixed at the end of the crane.

The step-bearing at the foot of the vertical mast was made by screwing a coupling on the 3-in. pipe and then a plug into the coupling. The coupling is finished on the outside and the plug is faced off to the coupling. A piece of brass is inserted in the bottom of the hole in the wooden block for a bearing plate.

The crane has a movement in the horizontal plane so that rails can be easily picked up off a car and swung around and unloaded, or vice versa, if the rails are to be loaded. It has a lifting capacity of about 1000 lbs., and does the work, with a crew of four or five men, that generally requires the services of about twenty men. In addition, it does the work very much more quickly and to better satisfaction. Three rails per minute can be loaded or unloaded with the apparatus. Air is furnished to the hoist from receivers that are charged from compressors mounted on the rear of the car.

SHOP, POWER HOUSE AND COMPRESSED AIR PLANT

Between the wood mill and the forge shop is the power house, a building 35 ft. x 45 ft. in size. The equipment supplies compressed air and steam for the shops. All the electric current for power and lights is taken directly from the 600-volt feeder system from the Key Route power house.

In the boiler room are two 125-hp Babcock & Wilcox boilers, arranged for burning crude oil. One boiler is also equipped for burning shavings, as it is the intention to install a shaving exhaust system in the wood mill which will carry the sawdust and shavings to a bin above the boilers. A 2000-gal. tank for crude oil storage is located under ground outside the power house.

In the engine room is a vertical compound 200-hp engine, belted to a tandem-compound air compressor. Air storage capacity is provided in two tanks, 36 ins. in diameter and 13 ft. 6 ins. long, located east of the power house. From these tanks a piping system runs to the stock room and all the shops, starting with a 5-in. main and distributing through 1-in. 1½-in. and 2-in. pipes. An auxiliary storage tank, 5 ft. in diameter and 13 ft. long, is located between the truck room and the machine shop. A pressure of 80 lbs. is maintained on the system. In the car pit in the truck room five risers are provided for blowing out armatures and cleaning purposes. Complete equipments of air tools are provided throughout the shops, including riveters, hoists, hammers, air blasts, etc.

An oil-distributing system is also provided, leading by a 1½-in. pipe from the oil pump in the power house to the forge shop furnace, and thence by a 1-in. pipe to the furnace in the foundry. The pipe is laid underground in a redwood box. Exhaust steam from the compressor engine and pumps will be used for heating the lumber kiln, and live steam will also be utilized when needed.

WATER AND SEWER SYSTEMS

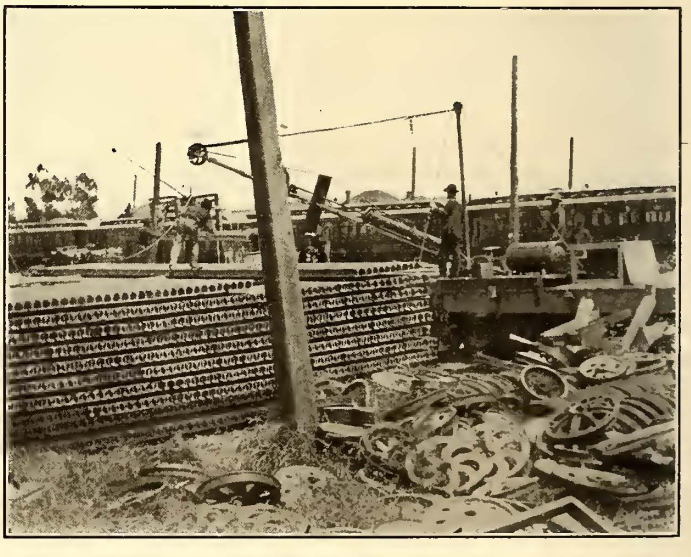
Water for fire protection and general supply is taken from the Contra Costa Water Company's city system, a 4-in. main connecting with all the buildings. In each shop several hose stands are provided, with 2½-in. cotton fire hose, so that nearly any spot can be reached by two lines of hose. Drainage from the roofs and buildings is provided for through 8-in. and 10-in. pipes, connecting with a large city storm sewer which is laid along the south side of the property. The transfer pit is drained by a separate system to avoid its filling up in case the roof sewer should become filled and back up.

THERMIT JOINTS

The company has just decided to install thermit rail-joints on a large scale, and has ordered 1400 welding portions from the Goldschmidt Thermit Company, of New York.

CONCLUSION

The shops were erected under the supervision of J. Q. Brown,



RAIL HOIST FOR UNLOADING RAILS, OAKLAND TRACTION SHOPS

assistant general manager and chief engineer for both companies. Mr. Brown has given his personal attention to the construction of the shops, and the general plan as well as many ot the details were put in according to his design. H. L. Griswold, Mr. Brown's assistant, has had immediate charge of the drawing of the plans, and has also worked out several of the original features of design. The master mechanic of both companies, whose ideas also were embodied in the general arrange-

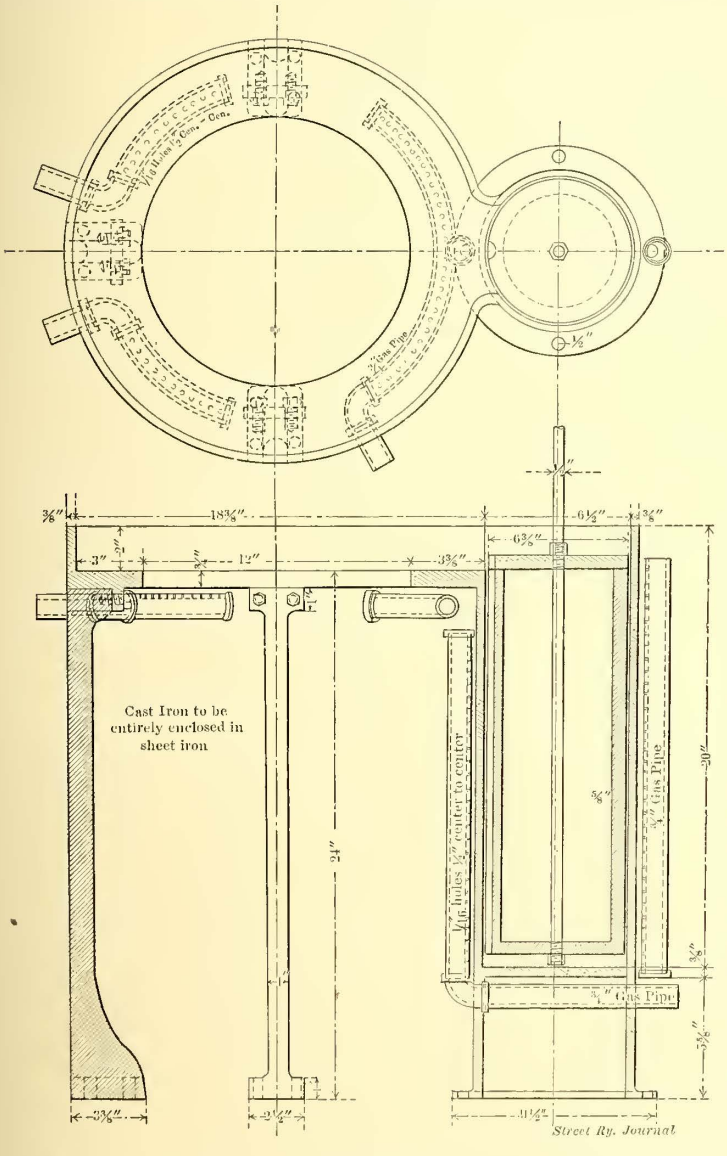
ment and who now has direct management of the shops, is George St. Pierre.

It is the intention of the companies not only to carry on all repairs to its cars in the shops, but also to build its own cars complete, work along the latter line having already been begun.

Acknowledgments of thanks are due to J. Q. Brown, F. W. Frost, H. L. Griswold, George St. Pierre and other officials of the Oakland Traction Consolidated for data, photographs and drawings used in the preparation of this article, and for many other courtesies extended.

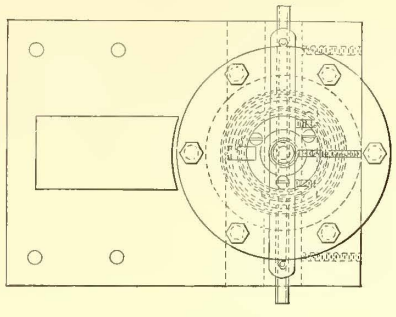
ARMATURE SOLDERING OUTFIT AND COIL PRESS AT DETROIT UNITED SHOPS

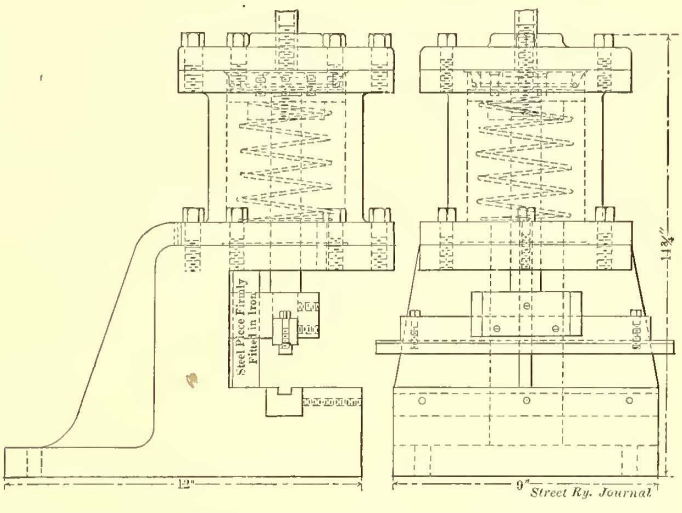
Through the courtesy of Sylvester Potter, master mechanic of the Detroit United Railway, the accompanying descriptions and drawings are given of a soldering outfit for soldering armatures, and pneumatic press for pressing armature coils into shape, both of which devices have been recently developed at the Detroit United Railway repair shops:



ARMATURE SOLDERING OUTFIT, DETROIT UNITED RAILWAY SHOPS

The armature soldering outfit, as indicated on the drawing, consists of a reservoir for hot solder and a shallow basin with a hole in the center. This hole is of sufficient size to allow the largest commutator to pass through until the slotted flange rests on the bottom of the basin. When it is desired to solder an armature, it is picked up by an air hoist, an asbestos ring is placed around the commutator tight against the slotted flange and the armature is set in place on end in the basin. Heat is then applied by jets of flame from a number of small holes in a ring of pipe encircling the commutator. When the commutator is heated sufficiently, the joints are well cleaned and solder is forced from the reservoir into the basin by screwing the plunger to the depth desired. The asbestos ring, held by the weight of the armature, keeps the solder from running through the hole in the center.





PNEUMATIC COIL PRESS, DETROIT UNITED RAILWAY SHOPS

When the connections are soldered, the surplus solder is allowed to run back into the reservoir and the armature is removed. The solder in the reservoir is melted by a single burner near the bottom. A mixture of gas and compressed air is burned, both for this purpose and at the commutator heating ring. To solder the smaller armature, there is kept in stock a number of plates, with holes of various sizes, to place in the basin for the purpose of supporting armatures of different diameters and designs.

The pneumatic armature coil press is used for pressing armature coils into shape after they have been formed. The press is operated by admitting air at the top from the shop storage-tank system by means of an ordinary motorman's valve. The air thus admitted forces the piston downward, together with the die attached thereto. The die fits into a slot in the base, flattening out the coil as desired. Dies and slots to suit different types of coils are made to fit the press.

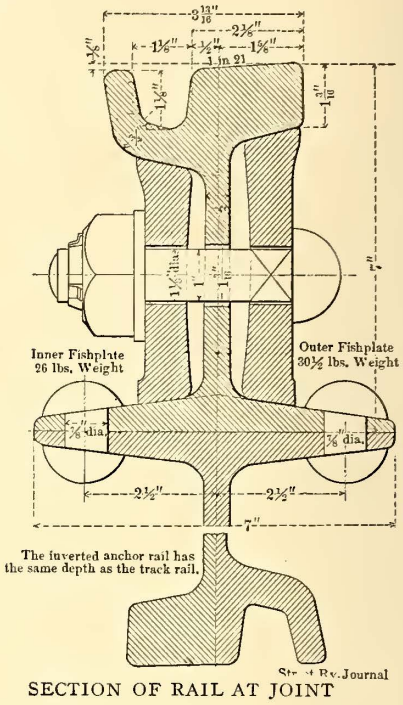
One boy operates two of these presses, pasting the paper and placing a coil in one press, while the other press keeps another coil under pressure and allows the paste to set firmly.

Four interurban baseball leagues are being formed, one in Northern Indiana, overlapping into Michigan; one in the gas belt; one in the Lebanon-Crawfordsville district, and one in the Princeton-Evansville district.

THE BELFAST TRAMWAYS

The tramways in Belfast were the last of those in any large city in the United Kingdom to be changed from horse to electricity, and the new electric system has just been completed. Belfast had a population in 1901 of 350,000, and the first tramways in the city were put in operation in 1872 by the Belfast Street Tramways Company. In 1893 the city, by the twenty-one-year act, was permitted to purchase them, but instead continued the company's lease for fourteen years. By subsequent agreement this was reduced to twelve years, and the city entered into possession of the system early last year. At that time there were 35 miles of track, all of which were being worked by horses. The amount paid by the corporation to the Belfast Street Tramways Company for its undertaking was settled by arbitration, and the amount awarded by the arbitrator, L. L. Macassey, including the value of three years unexpired lease and compensation to officers, was £364,448.

VIEW OF THE TRACK LAYOUT AT FISHERWICK PLACE AND GROSVENOR ROAD



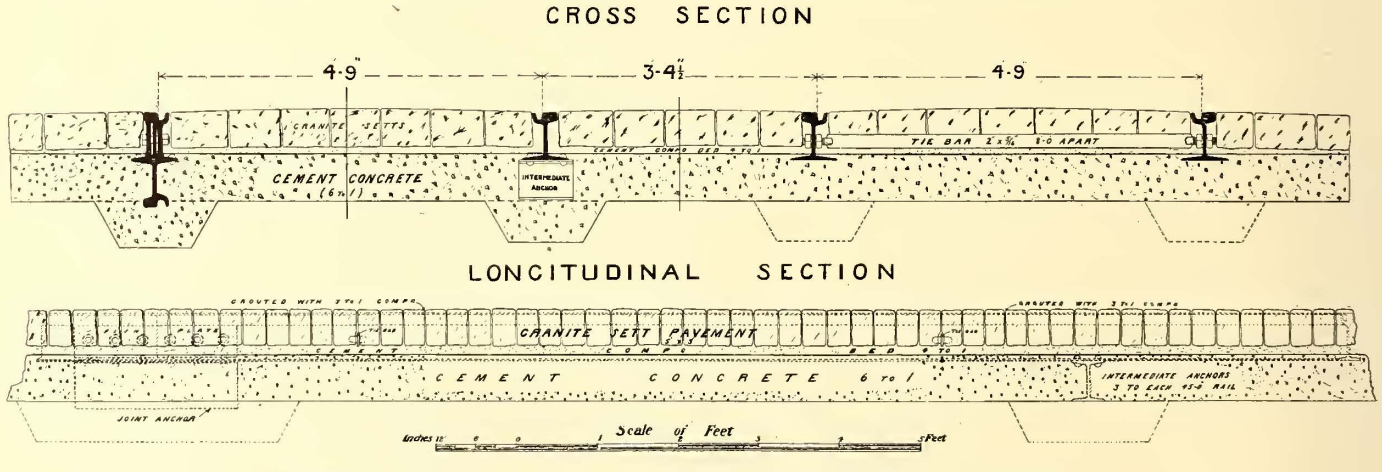
SECTION OF RAIL AT JOINT

In July, 1904, Henry A. Cutler, M. Inst. C. E., the city surveyor, and V. A. H. McCowen, M. Inst. E. E., the city electrical engineer, reported to the newly-formed tramways committee of the corporation on the various systems of electric traction, and strongly recommended the adoption of the overhead trolley system. This report was adopted, and Mr. Cutler was instructed to prepare drawings and specifications for the permanent way and the buildings; Mr. McCowen to prepare a scheme for the electrical operation of the system, including specifications for the generating plant, cables and overhead equipment; and Mr. Nance, who had for many years managed the horse tramway system under the old company and had been appointed manager for the corporation, to prepare a specification for new rolling stock, and to make the necessary alterations and additions to the car sheds and depots. After the specifications had been submitted to Lacy, Sillar & Leigh for expert advice, tenders were invited for the work of reconstruction of the tramways, excluding the buildings, in six different sections, and eventually the tender of J. G. White & Company, of London, for the whole of the six sections, amounting to £543,404, was accepted.

PERMANENT WAY

All the routes were laid as double line to a gage of 4 ft. 9 ins., and the work now completed consists of about 80 miles, measured as single track. Sixteen single-track miles of the tramways were laid only five years ago, and as this portion of the work was in fair condition, the renewal of the special work, bonding and general repairs was the only work necessary in connection with them. British standard sections were adopted for the rails and fish-plates used in the new track. No. 4 section, weighing 105 lbs. to the lineal yard, was used on the straight and flat curves, and No. 4C section, weighing 111 lbs. to the lineal yard, on curves of 66-ft. radius and under. The rails were manufactured by the North Eastern Steel Company.

Bridge joints are used, consisting of 2-ft. lengths of rail inverted and riveted to the under flange of the rails, with twelve

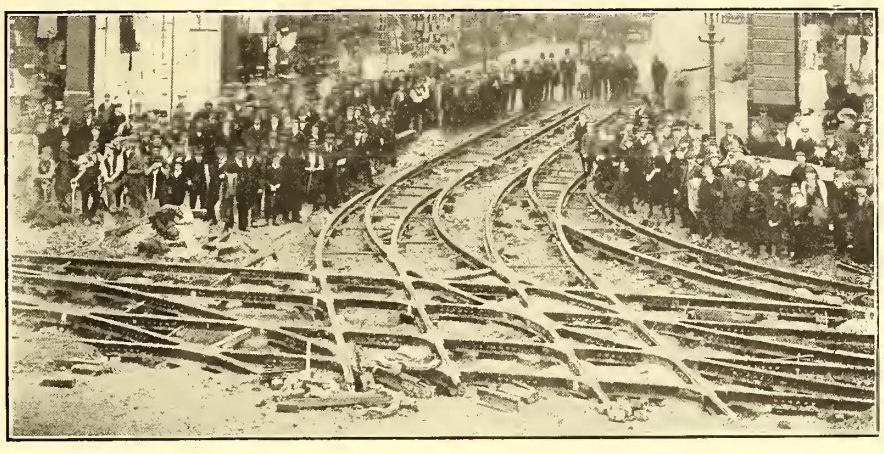


CROSS AND LONGITUDINAL SECTIONS OF BELFAST TRAMWAYS ROADBED

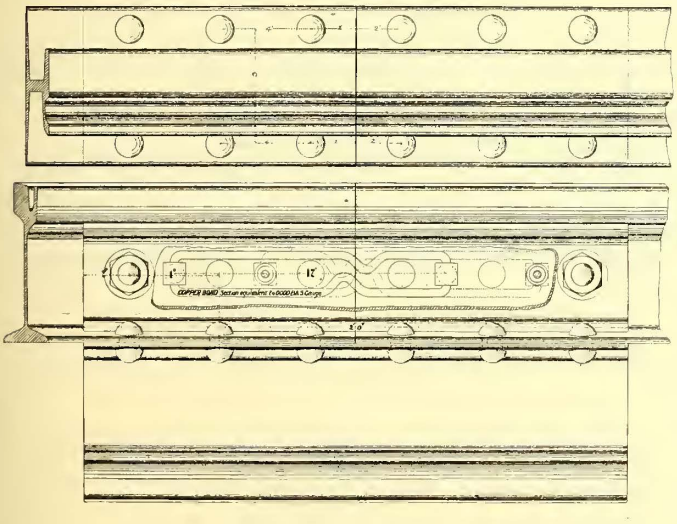
Bridge joints are used, consisting of 2-ft. lengths of rail inverted and riveted to the under flange of the rails, with twelve

rivets at each joint. Attached to the rail between the joints are intermediate anchors spaced about 11 ft. apart, consisting of sections of steel joists 8 ins. long riveted transversely to the under flange, with four rivets to each anchor. The tie-bars are of mild steel, 2 ins. x ¼ in. The joint bonding has been executed with two 0000 B. & S. gage copper bonds of the protected type. Solid crown cross bonds have been put in at 40-yd. intervals in the tracks and 80-yd. intervals between the tracks.

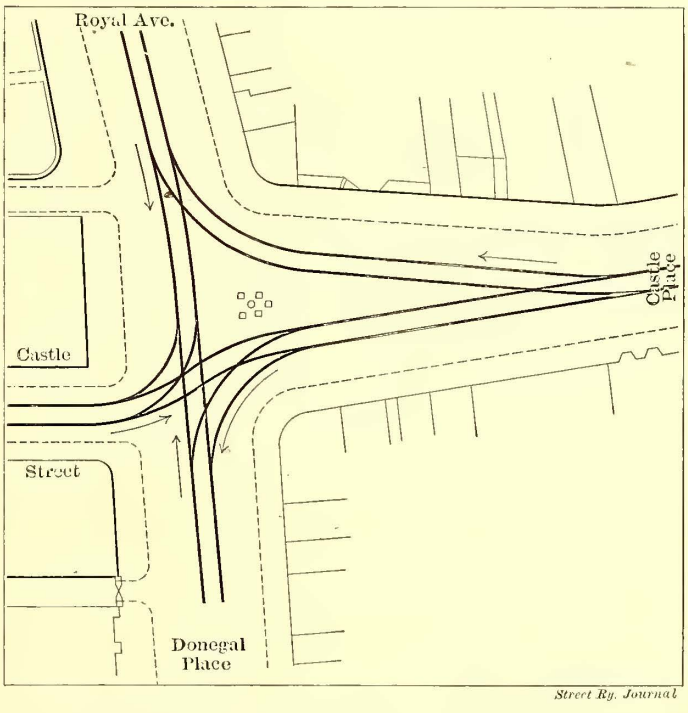
All of the special work was supplied by the Lorain Steel Company. The switches at junctions are made to a radius of 150 ft., and are fitted with manganese steel insert pieces. The crossings are of the iron-bound type, with steel armored centers. The special work was manufactured and fitted together at the company's works in America and delivered on the ground ready for laying. The care with which the work had been designed and manufactured enabled it to be put together on the site without the slightest trouble. Owing to the close spacing of the rail anchors, it was possible for some modifications of the usual method of track laying to be made, and do away with the necessity for removing temporary rail packings after the concrete had been put in. The method of track laying adopted was to align the rails and then put in the concrete packing. The concrete under the rails consists of broken stone, gravel and cement, mixed in the proportions of 6 of the aggregate to 1 of cement. Its normal thickness is 7 ins., and the upper surface was finished 1 in. above the rail bed. Where the foundation was considered unreliable, the thickness of the concrete was increased, in some places to as much as 12 ins. The paving consists of granite blocks, 5 ins. to 5½ ins. deep and 3 ins. to 4 ins. wide. They are laid on a dry compo bed, mixed in the proportions of 4 of sand to 1 of cement, which was thoroughly wetted after the paving had been laid. The joints were then grouted up with 3 to 1 compo, and back washed after the paving blocks had been rammed. In the greater part of the work the rails were not parged, as the grouting was found to fill the space between the paving blocks and the web of the rail, and to make a more satisfactory job. In some places where it was necessary to turn the traffic on the road immediately after completion, such as at road crossings, the rails were parged, the block bedded on sand, the joints racked up with chippings and grouted with pitch and creosote oil.



SOME SPECIAL WORK AT CASTLE JUNCTION ON THE BELFAST TRAMWAYS SYSTEM



SIDE ELEVATION AND PLAN OF JOINT



PLAN OF SPECIAL TRACK WORK AT DONEGAL PLACE

POWER STATION

The contract for the power station building was let to local contractors. The site of the building adjoins the electric light station and is very centrally situated, close to the bank of the River Lagan, which is navigable for barges to the site of the works, and will provide an unfailing supply of water for condensing. Work was commenced in April last, and owing to the soft nature of the ground, some 1750 piles had to be driven through 30 ft. of river mud down to the rock. The foundations on top of the piles are formed with cement concrete, in which is embedded a steel grill work made of old tram rails. The new building is faced with red brick, with stone dressings. The floors in the basement are formed of concrete, and the stoking floor and switch gallery floors are of concrete on steel joists. The stoking floor is finished with blue paving bricks; the switch gallery floors with vitreous glass mosaic, and the floor of the engine room with encaustic tiling. The walls of the engine house and switch galleries are faced with glazed tiles.

PUMP HOUSE

The pump house is 68 ft. long and 16 ft. 6 ins. wide, and is of red brick, with stone dressings. The pump wells are built in concrete, faced with blue brick, and the openings to the river

are protected with movable screens. The pumps are carried over the pump wells on steel joists, and the floor is constructed of concrete and paved with tiles.

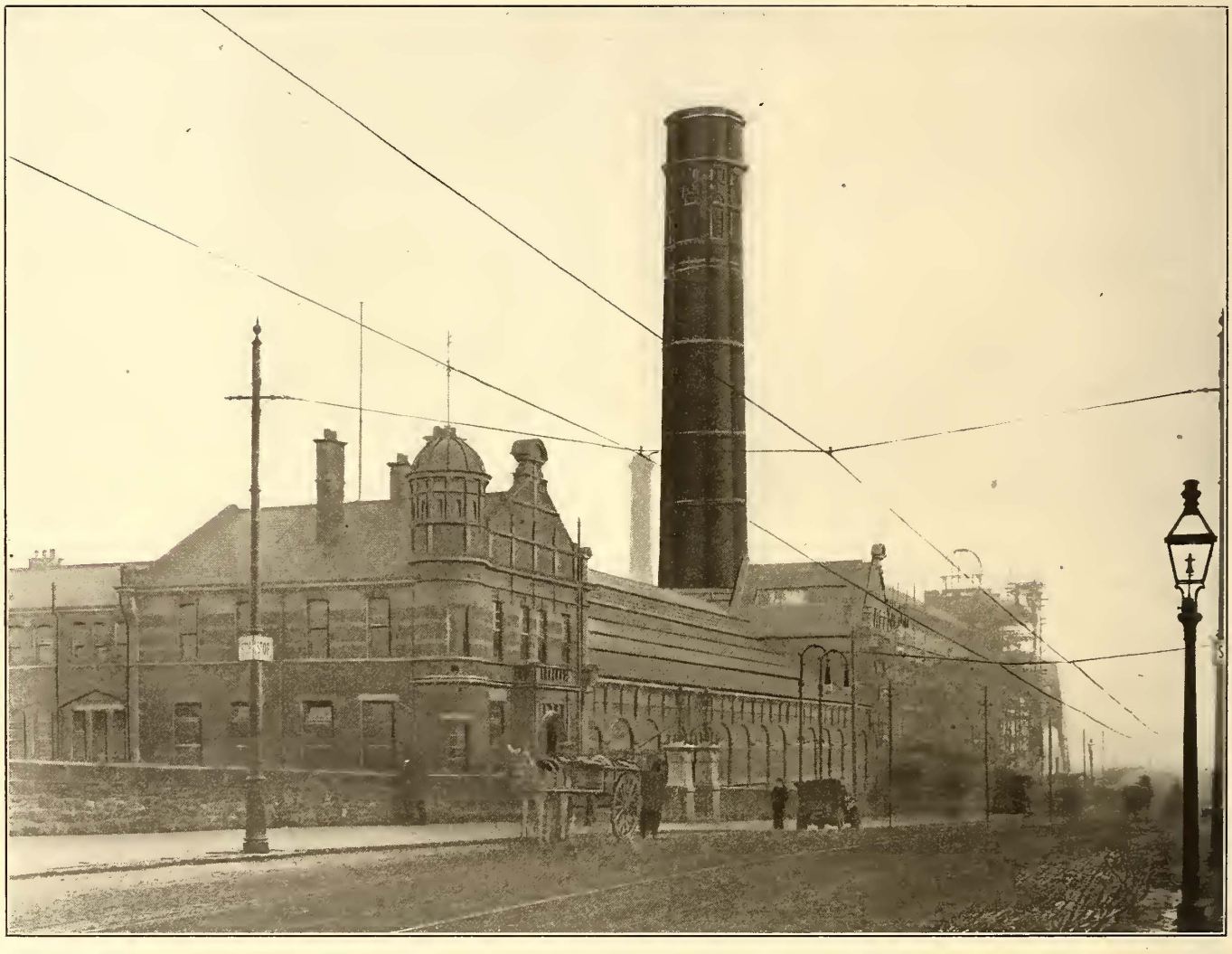
ELECTRICAL EQUIPMENT

As the railway station forms an extension of the existing lighting station, which was erected in 1898, all the plant installed has been arranged for both lighting and traction supply. The new generators have therefore been provided with compound windings for tramway supply at 550 volts, and can supply lighting current at 440 volts to 500 volts on the outers of the three-wire system. The plant in the original station consists of high-speed dynamos, with a total capacity of 3400 kw. The engines throughout are of Belliss & Morcom's make, by a line shaft beneath the stoking floor, and connected by clutch gear to duplicate electric motors geared by means of worm reduction gear.

The economizers are of Green's make, 128 pipes to each boiler. The scraper gear of each economizer is also electrically driven through worm gearing.

An elaborate coal and ash-conveying system, installed by the manufacturers of the boilers, is in use.

The arrangement of steam pipe work is extremely simple, as can be seen in the plan. Each boiler, economizer and steam generator forms a unit, and is connected by means of an 8-in. steam pipe. A 10-in. main steam pipe in the boiler house simply acts as an equalizer between the various units. The pipes are of weldless mild steel, having a tensile strength of 24 lbs.



THE POWER STATION OF THE BELFAST TRAMWAYS

and three of the large lighting generators can be run on the tramway load, if required.

BOILERS AND AUXILIARIES

The layout of the boiler house is shown in the plan. Each boiler is provided with its own economizer immediately at the back, and this opens direct into the main flue. By this means the economizers receive the full heat value of the waste gases before cooling, due to radiation or leakage, can take place. Four Babcock & Wilcox water-tube boilers have been erected in the railway extension. Each boiler has a heating surface of 5764 sq. ft. and a grate area of 100 sq. ft., and is capable of evaporating from 20,000 lbs. to 25,000 lbs. of water per hour from and at 212 degs. F. Each boiler is fitted with a B. & W. patent superheater having 900 sq. ft. of heating surface, and capable of imparting a superheat of 150 degs. F. to the steam produced by the boiler. Each boiler is also provided with a double 5-ft. x 10-ft. chain grate stoker. The stokers are driven

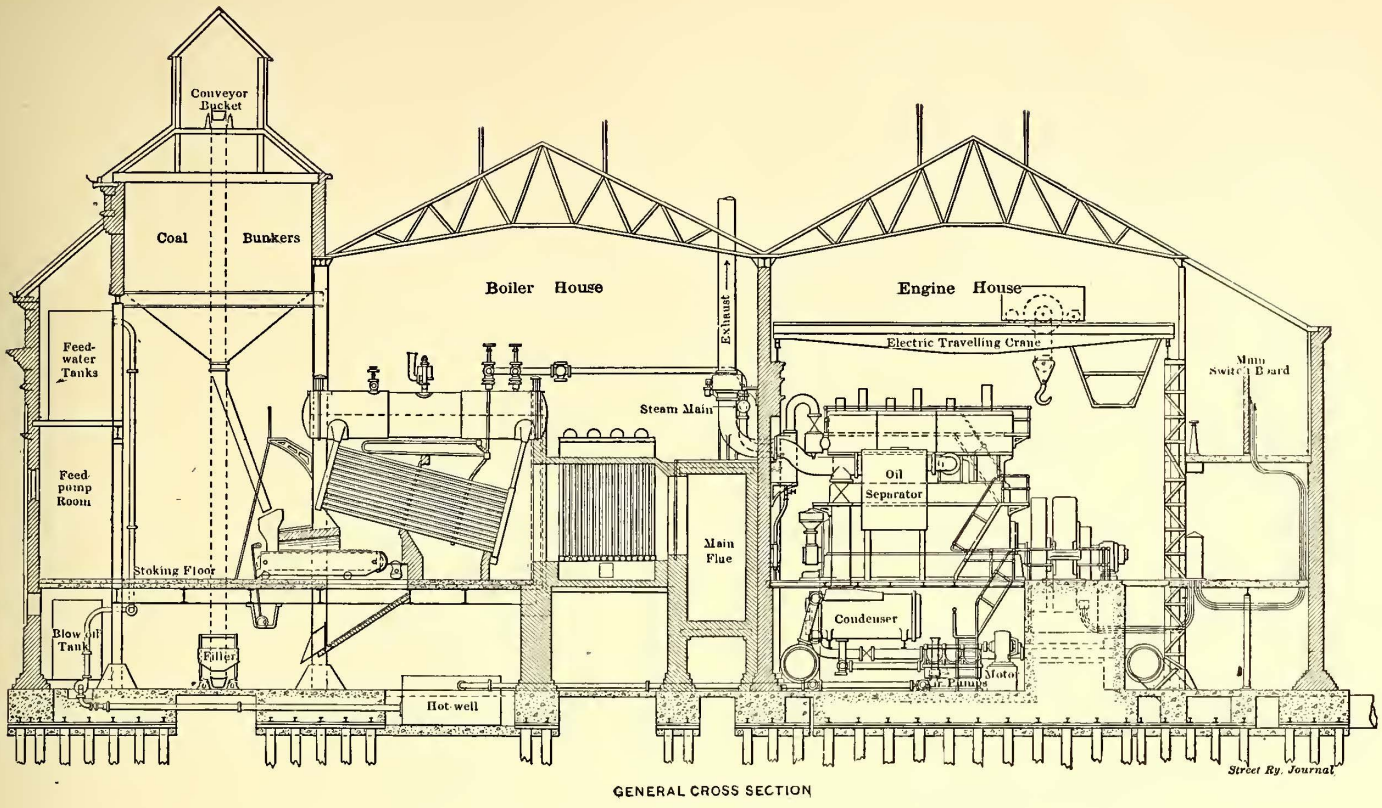
to 27 lbs. per square inch, with an elongation of 20 per cent in a length of 6 ins. No cast-iron or copper pipes are employed.

A duplicate system of boiler feed is provided throughout, and the supply is taken from the water mains. The feed-pumps consist of one compound vertical steam pump and two electrically-driven pumps, each capable of delivering to the boilers 8000 gals. of water per hour against the boiler pressure. The following are the guaranteed figures for the feed-pumps: Steam pump, 110 lbs. of water pumped per pound of steam; electric pumps, 3600 lbs. of water pumped per kw-hour.

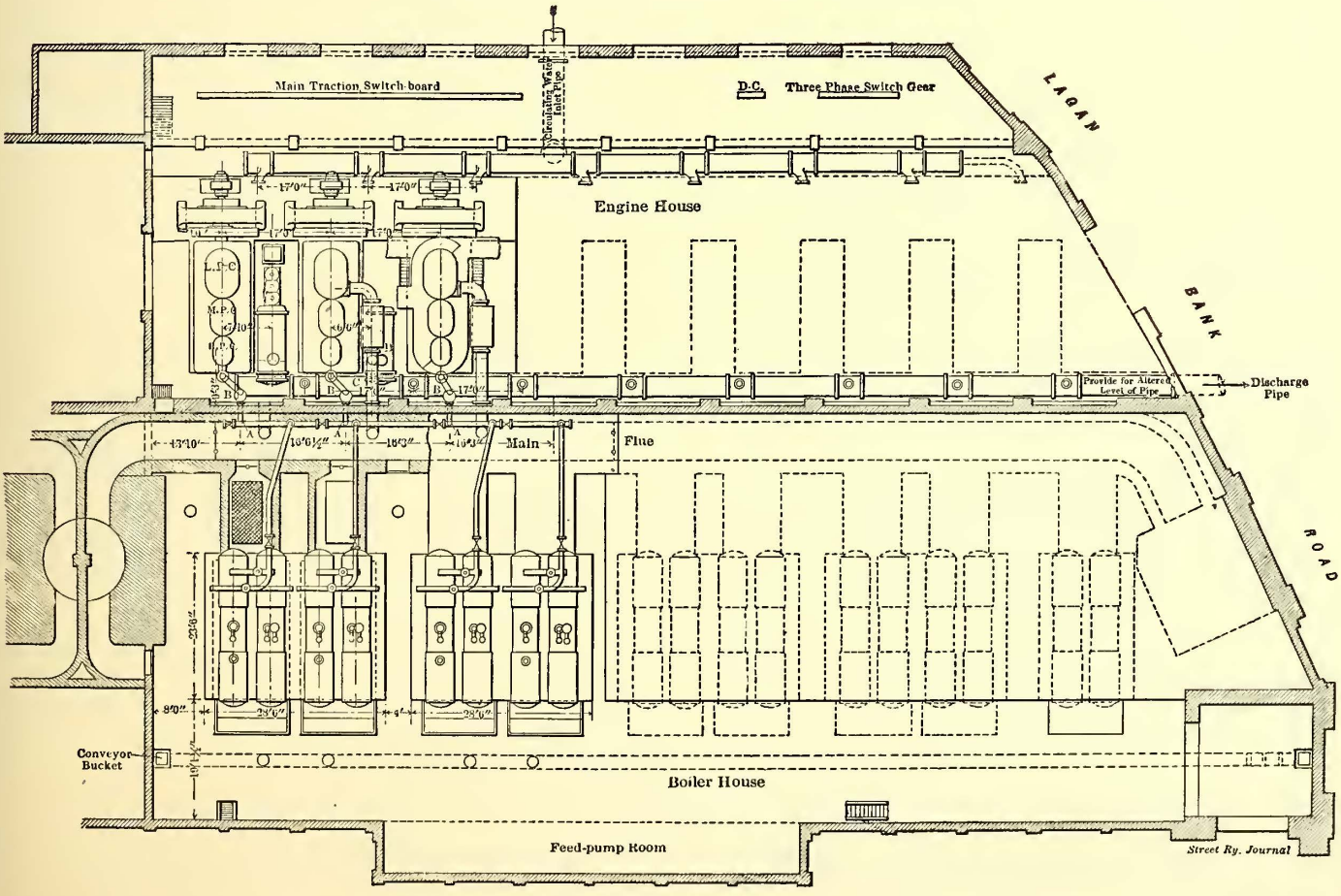
The valves employed throughout are of Hopkinson's make, for a working pressure of 200 lbs. per square inch, with outside screw spindles.

ENGINES AND GENERATORS

The generating plant erected in the railway extension consists of three 1000-kw d. c. engine units. The engines are of the vertical inverted, three-crank, triple-expansion, enclosed



GENERAL CROSS-SECTION OF EXTENSION OF BELFAST GENERATING STATION



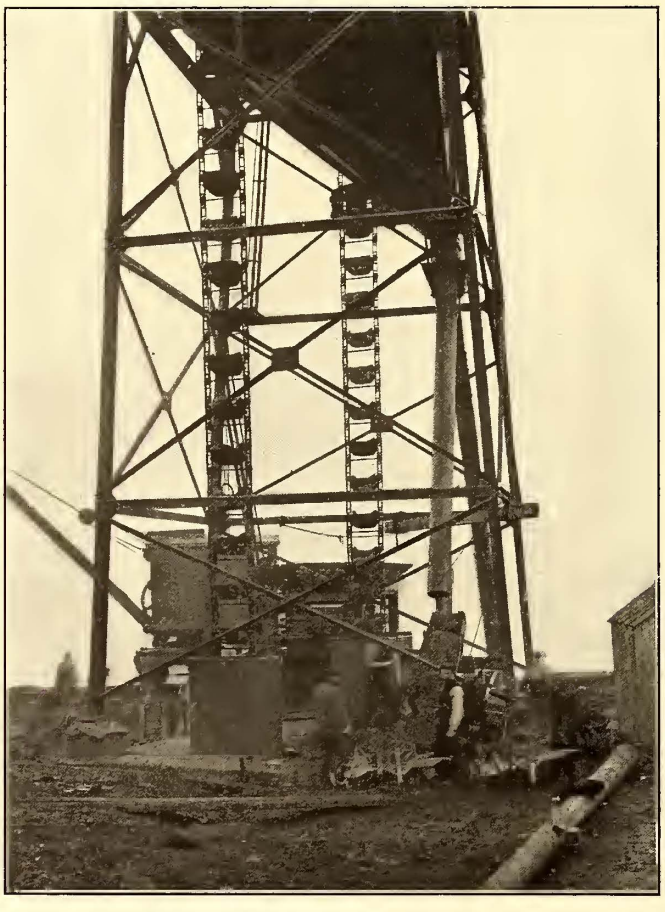
PLAN OF TRACTION EXTENSION OF BELFAST POWER STATION, SHOWING PRESENT AND FUTURE LAYOUT

type, with forced lubrication, made by Combe Barbour, Ltd., of Belfast, and constructed to run at a speed of 180 r. p. m. with steam pressure of 170 lbs. per square inch and 150 degs. F. of superheat. The cylinder dimensions are 22 ins., 33 ins. and 50 ins. by 24-in. stroke. The steam consumption at full load condensing under the above conditions of steam pressure and temperature, and with 25 ins. of vacuum, is guaranteed at 16¾ lbs. per kw-hour, subject to additions or deductions of £250 per engine for every pound of steam per kw-hour below or above that figure.

CONDENSING PLANT

The condensing plant is of the counter-current surface type, with three-throw Edwards air pumps, manufactured by Mirrlees-Watson Company. The circulating water is obtained from the river by means of electrically-driven centrifugal pumps, arranged in a pump house on the river bank. Three Gwynne electrically-driven centrifugal pumps are at present erected, two 12-in. and one 15-in., and provision is made for the erection of two more when required.

Each main engine is provided in the basement with a separate condenser, having 2350 sq. ft. of cooling surface, and an electrically direct-driven three-throw Edwards air pump. The discharge from the air pump gravitates into a large cast-iron



ASH DISCHARGE ON WHARF

tank in the boiler house basement, and is lifted from thence to the hot well over the feed-pump house by means of electrically-driven centrifugal pumps.

An exhaust steam grease separator is placed between the engine and the condenser. Each engine is also provided with an atmospheric exhaust controlled by an automatic valve, which opens in the event of the vacuum failing, so that the sets can run non-condensing.

THREE-PHASE PLANT

Energy is transmitted at 6000 volts, three-phase, to a sub-station at the Fort William Depot for operating the portion of the system in that district, and for the supply of current to the Cavehill & Whitewell Tramway Company. This current is generated at 50 cycles by two 250-kw, three-phase, synchronous motor generators in the power station. The sub-station contains three similar equipments, except that they are of 125-kw capacity and that each is provided with a small three-phase induction starting motor mounted on the other end of the shaft. The efficiencies guaranteed for these machines are as follows, the efficiency being taken as the ratio of the d. c. input to the a. c. output:

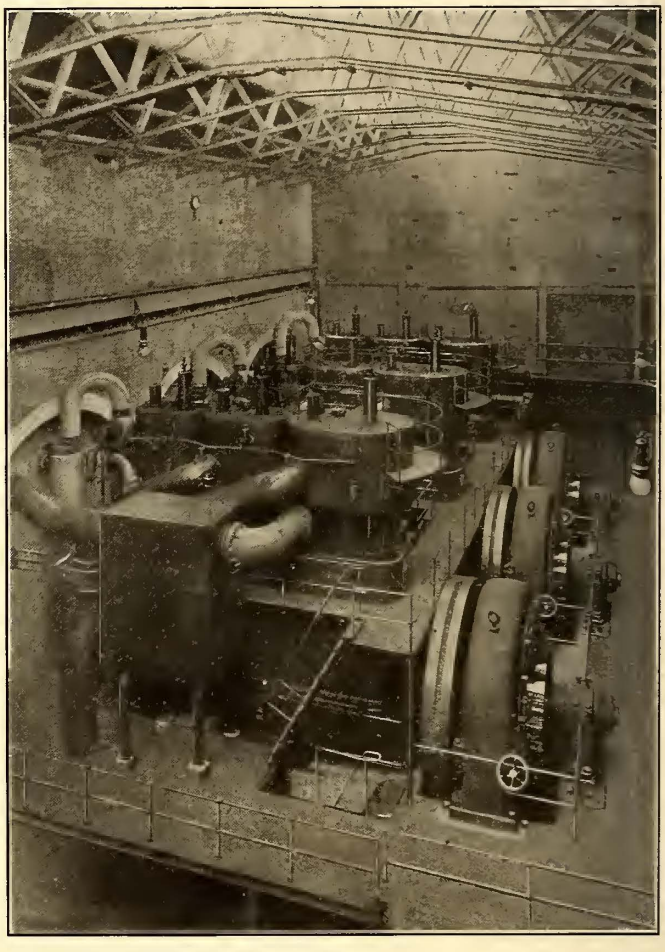
Load	250-kw Set Per Cent	125-kw Set Per Cent
1	87	83½
¾	86	82
½	82	78

The three-phase apparatus is of the Westinghouse make.

The sub-station is situated about 3 miles from the generating station, and is connected by means of a duplicate electric high-tension three-core trunk main, the section of each core being 0.075 sq. in. These cables are lead-covered and armored, and laid in earthenware troughs filled in solid with bitumen.

SWITCHBOARDS

The main traction switchboard and the three-phase operating switchboard are erected on a gallery which runs the full length



NEW ENGINE HOUSE IN THE BELFAST POWER STATION

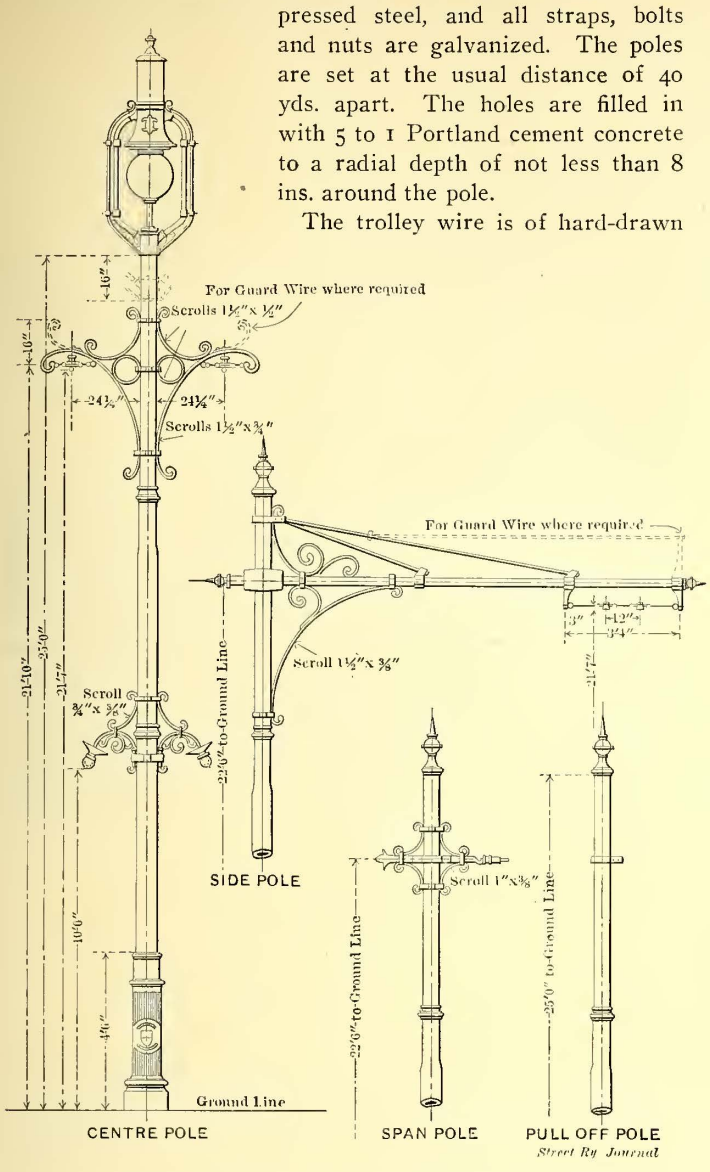
of the engine room at a height of 12 ft. above the main floor level. The main switchboard carries the usual apparatus, including a Board of Trade panel. All panels are of white Sicilian marble 2 ins. thick. The over all height is 92 ins., and the total length of the board is 50 ft. The Board of Trade panel is equipped with Elliott instruments.

OVERHEAD EQUIPMENT

The overhead equipment was installed by J. G. White & Company. The greater portion is of span wire construction, with the exception of 2½ miles of side bracket on outlying districts, and 2¾ miles of center pole construction in the wide main thoroughfares in the center of the city.

The poles are of lap-welded mild steel of the sectional type to the British standards specification. The pole fittings are of pressed steel, and all straps, bolts and nuts are galvanized. The poles are set at the usual distance of 40 yds. apart. The holes are filled in with 5 to 1 Portland cement concrete to a radial depth of not less than 8 ins. around the pole.

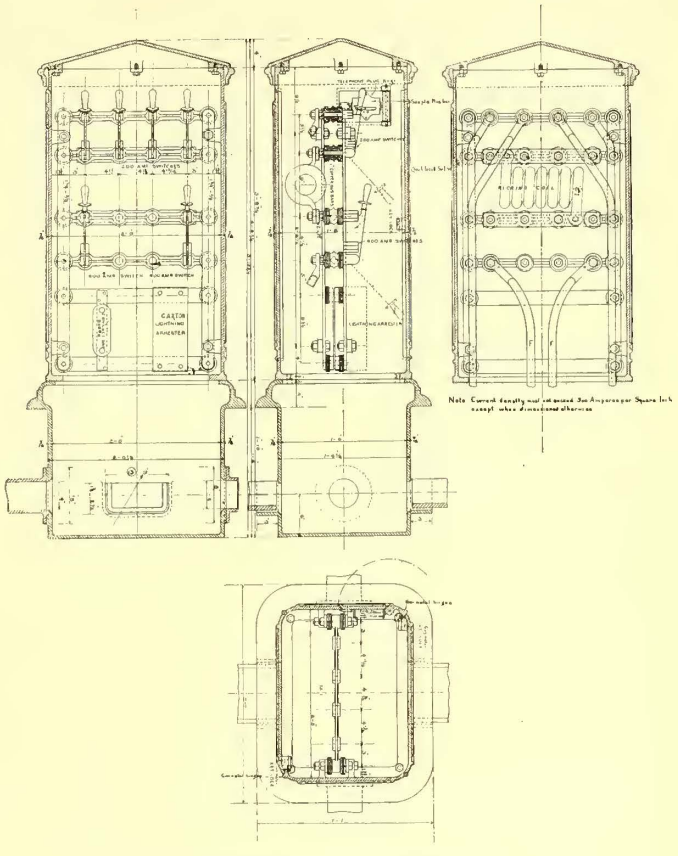
The trolley wire is of hard-drawn copper, 0.4 in. in diameter, with a breaking strain of 24 tons per square inch. It is double throughout, and is fixed at a height of 22 ft. above the track, flexible suspension being adopted in all cases. The trolley wire is arranged for center running on all span work, and the maximum deviation allowed in any case is 6 ft. from the center of the track. On curves, the wire in no case assumes an angle of less than 160 degs.



TYPES OF POLES ON THE BELFAST TRAMWAYS

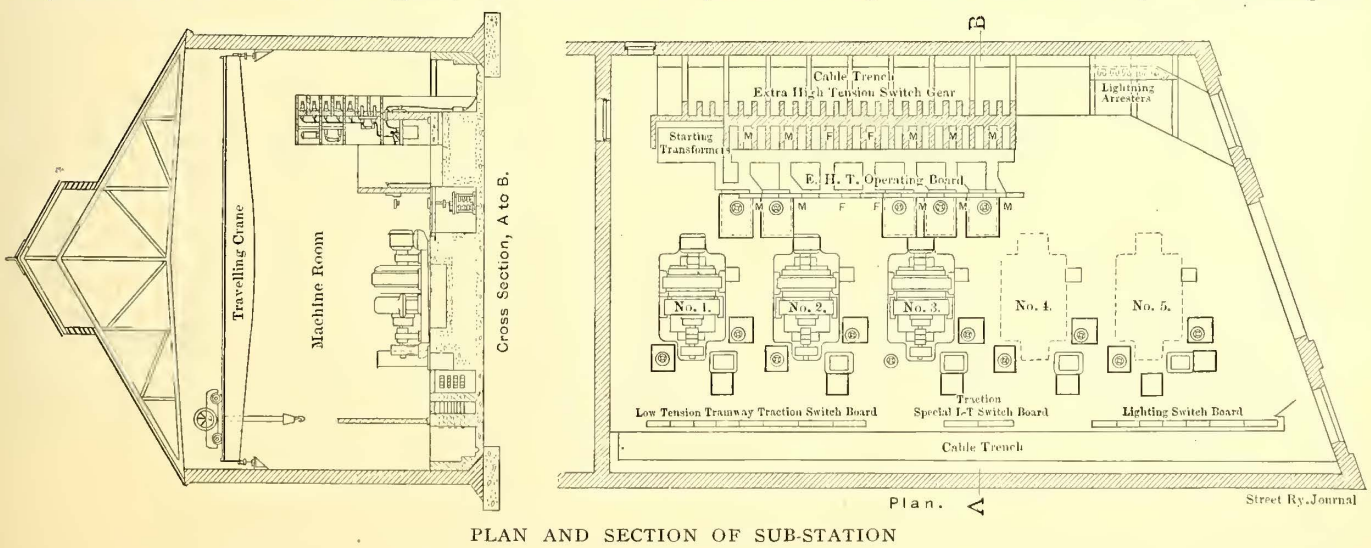
Eighteen-inch ears are employed on the straight, and 30-in. and 33-in. ears on curves. The sectional insulators are of the straight under-running air-gap pattern, and are capable of standing a strain of 4000 lbs. The span wires are of 7/12's S. W. G. galvanized steel, with a breaking strain of not less than 4000 lbs. Duplicate insulation is employed throughout. The insulator bolts are ¾ in. in diameter, and both insulators and Brooklyn strains are capable of withstanding a strain of 6000 lbs.

The guard wires are of 7/16's S. W. G. galvanized steel, with a breaking strain of 2500 lbs. Guard wiring, however, has been reduced to a minimum, as the corporation, on the advice of Mr. McCowen, has required the telephone company to put all its telephone wires on tramway routes underground. It is expected that this will considerably minimize troubles with the overhead equipment.



SECTION AND FEEDER PILLAR

Section feeder pillars are placed ½ mile apart on all routes, and at shorter distances in the center of the city to suit local conditions. These pillars are arranged for double insulation,



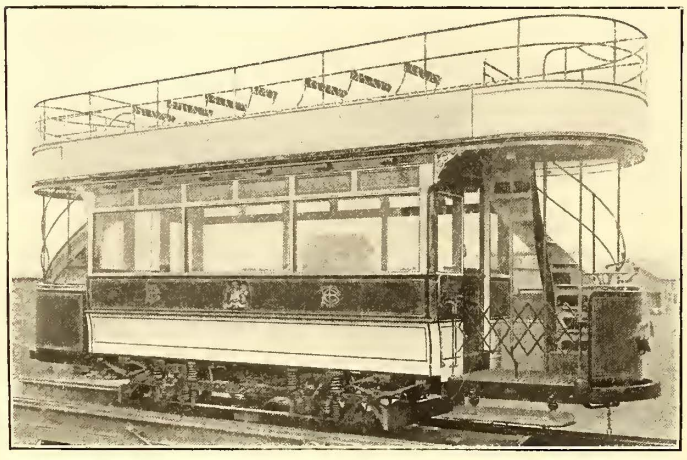
PLAN AND SECTION OF SUB-STATION

and each is provided with the following switching apparatus:

Two 400-amp. quick-break switches.
Four 200-amp. quick-break switches.
One bus-bar of 1 sq. in. section.
One lightning arrester and kicking coil.
One terminal board for telephone and test wire terminals, and
One telephone plug box.

The current density for all switches and connections is 500 amps. per square inch.

A small separate door is provided for getting to the telephone plug boxes, and owing to trouble from damp experienced with telephone instruments placed in pillars, the usual method has been departed from and plug boxes only are provided in the pillars. The instruments themselves are provided with an induction coil in the handle, and an instrument is taken on each car, which can be plugged on to any pillar, and communication made with the power house or car sheds as desired.



BELFAST STANDARD DOUBLE-DECK CAR

The center poles are lighted by means of two incandescent lamps fixed on each pole at a height of about 12 ft. from the ground. These lamps are simply for the purpose of indicating the position of the poles at night and not for street lighting, and are supplied from the lighting mains. Provision was made for erecting arc lamps on the center poles for street lighting, but this matter has been deferred for the present.

The overhead equipment in the six car sheds and over the approaches has been carried out by Mr. McCowen's own staff. Mechanical ears have been employed throughout this work, which has resulted in a considerable saving in cost and gives excellent running. In some of the larger sheds one trolley wire is arranged to serve two lines of track. This method has been adopted with a view to reducing complications in the overhead special work, and, as in one case, as many as seventeen tracks are taken off the two approach tracks, and in another twenty tracks are taken off a single track, the possible complications of overhead equipment can be imagined.

MOTOR TOWER WAGON USED IN BELFAST

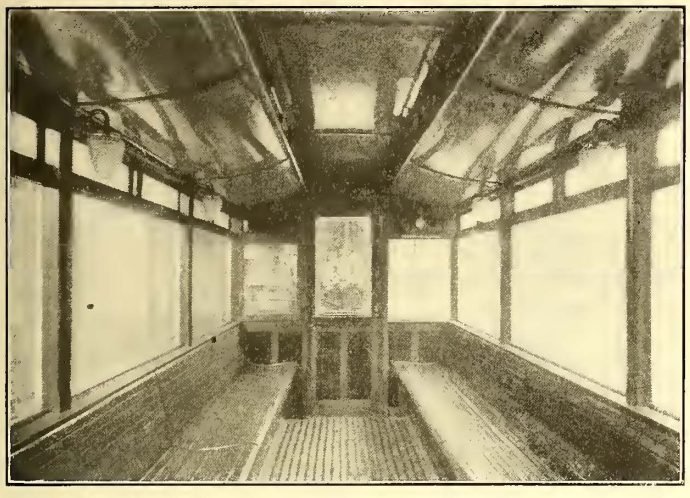
INTERIOR VIEW OF THE BELFAST TRAMWAYS CAR HOUSE AT FALLS ROAD

The overhead wiring of each shed is separated from the street wiring by sectional insulators, and the supply of energy to each shed is controlled by a circuit breaker and wattmeter, so that the energy used in the sheds can be carefully watched and the outside lines protected from interruptions due to faults

in the car sheds. The approaches to each shed are brilliantly lighted by means of arc lamps supplied from the lighting mains where these are available, and in the other case from the tramway supply.

CABLES

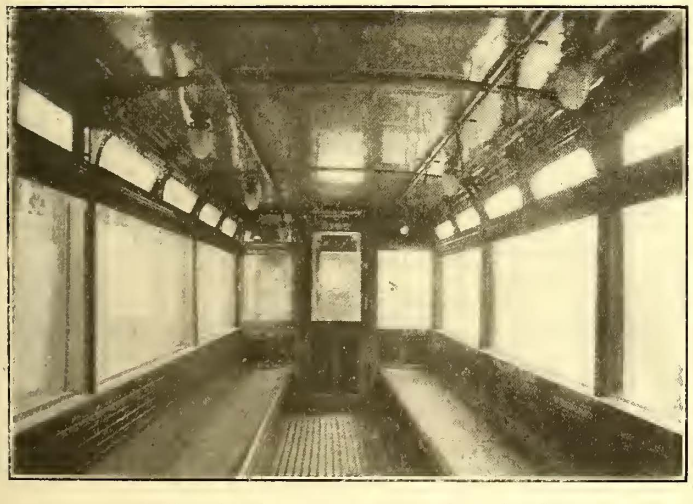
All of the cables required were manufactured and laid by Callender's Cable & Construction Company, Ltd., of London and Erith. The total trench work required amounted to 65,000



INTERIOR OF CONVERTED BELFAST HORSE CAR, SHOWING LIGHTING SYSTEM

yds., or 57 miles, of route, and the total amount of cable amounted to 93 miles. The weight of copper used was more than 250 tons.

The tramway feeders are all single conductor vulcanized bitumen cables, and are made up of a strand of soft copper wire, with a conductivity of not less than 100 per cent of Mathiessen's standard. The cables were subjected at the works to a pressure test of 2500 volts alternating. The pilot cables for the tramway feeders are three-core, 7/20, paper, vulcanized



INTERIOR OF STANDARD BELFAST CAR

bitumen insulated. The rail return cables and the Board of Trade pilot wire from the four Board of Trade pillars were also made in accordance with the above specification.

In addition to these cables, a three-phase high-tension main was laid in duplicate from the generating station to Fort William Depot. These cables were three-core, paper, lead-sheathed and single-wire armored, suitable for a working pressure of 6000 volts, with the center point of the star winding unearthed. These high-tension cables were subjected at the works to a test of 12,000 volts alternating.

All the cables were laid on the "solid system" on specially designed porcelain bridges in earthenware troughing.

At four points on the route, where the return feeder cables were connected to the track, four pillars, designed and manufactured by Messrs. Callender, were erected and coupled up complete in accordance with the requirements of the Board of Trade. Each pillar contains:

One bus-bar having a sectional area of 2.5 sq. ins., with disconnecting lugs for connecting the four cables to the rails and two return feeder cables.

One double-pole throw-over switch for 100 amps.

One maximum-demand indicator, capable of carrying 75 amps. in one of the pillars and 80 in the other three.

One circular pattern ammeter reading from .05 to 5 amps.

One 3-cell Laclanche battery in box.

Along the various routes there are placed seventy-six feeder pillars and eight section pillars, into which the feeder and telephone cables were looped at distances of approximately ½ mile. These were of British Electric Equipment Company's make. The connection between the feeder and section pillars and the overhead trolley wire has been made by means of single-conductor, rubber, lead-sheathed cables of 5000-megohm grade.

CARS AND TRUCKS

The number of cars ordered was 170, and for this part of the contract the corporation selected the tender of the Brush Electrical Engineering Company, of Loughborough. The cars are of uniform type and capacity, and may be accepted as typical of the British single-truck, double-deck car. The over all dimensions are 28 ft. in length, 6 ft. 10 ins. in width and 13 ft. 2½ ins. in height. The length of each platform is 5 ft. 6 ins., and there is a clear height inside at the center of 6 ft. 9 ins. The passenger capacity is twenty-two inside and thirty-two outside. The weight of the car without passengers, but including electrical equipment, is about 20,000 lbs. The cost was £586 per car. Especial features which attract attention in these cars are the systems for ventilation and lighting. As shown in the side view of the car, ventilation is secured through six wing scoops on the letter board, which point forward, and six which point backward. The lamp for lighting the interiors in both the new and converted cars are enclosed in ornamental globes.

The electrical equipment was supplied by the British Westinghouse Electric & Manufacturing Company, and consists of the No. 200 motors with 90-M series-parallel controller.

The cars are mounted on Brush trucks of the standard type, with a wheel base of 6 ft. 6 ins. Steel-tired wheels are used, and the trucks are fitted with Hudson-Bowring life-guards.

OFFICERS

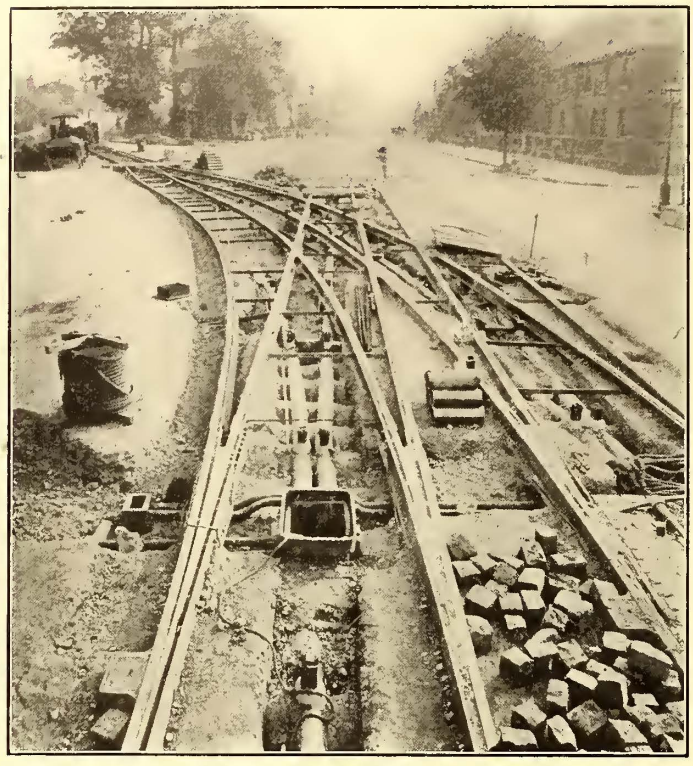
This paper is indebted to H. A. Cutler, city engineer; V. A. H. McCowen, city electrician, and Andrew Nance, general manager of the tramways, for courtesies extended in the preparation of this article.

NEGOTIATIONS PENDING FOR RAILWAY BETWEEN BUFFALO, LOCKPORT AND ROCHESTER

The Niagara Falls Electrical Transmission Company is said to be negotiating for the purchase of the Buffalo, Lockport & Rochester Railway Company, together with all the right and title to the railway company's right of way from Rochester to Lockport. The railway company, which is capitalized at $2,000,000, is building an electric railway to connect Rochester and Lockport. The right of way, which is of itself a very valuable thing for the transmission company to own at this time, has been secured for the entire distance, but the construction has progressed in part only to a point between Spencerport and Adams Basin. At no point on the line, except in the village of Albion, have any rails been laid. It is understood that the purchase, if made, will not be by the transmission company direct, but by persons as individuals who are large stockholders in the transmission company.

SURFACE CONTACT SYSTEM IN LINCOLN

The popularity of surface contact systems in England is evidenced by the equipment of the lines of the Municipal Tramways Company, of Lincoln, with the system of the G. B. Sur-



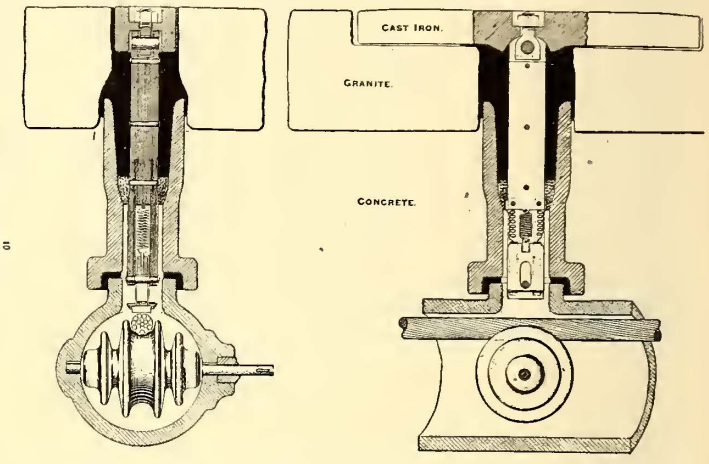
A JUNCTION ON THE LINCOLN CONDUIT SYSTEM

face Contact Company, of London. Lincoln is one of the old cathedral towns of England and has a population of about 50,000 inhabitants. Horses were used as a motive power until about two months ago, when the first section of electrified line,

CONDITION OF TRACK WHEN PAVING

consisting of 1¼ miles of double track and ½ mile of single track, was put in operation.

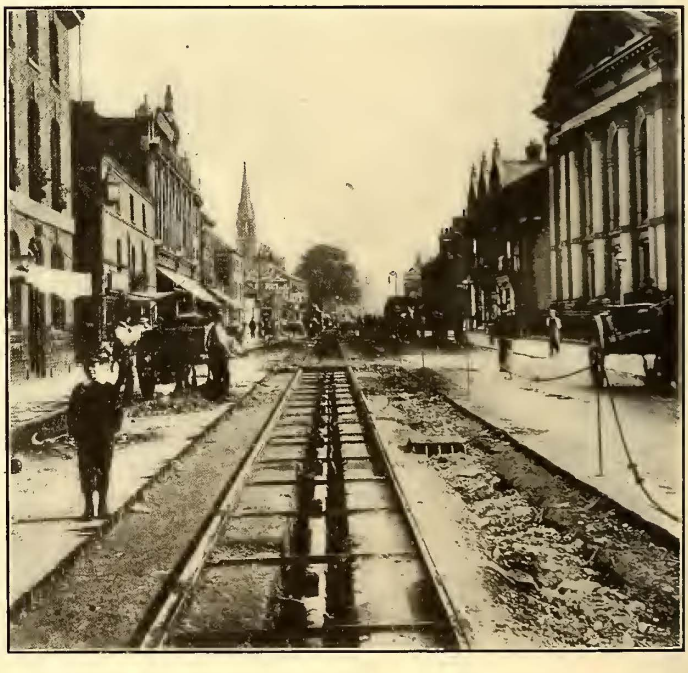
The G. B. surface contact system had previously been in experimental use on a short section of line in London, but this is the first commercial installation. The current is supplied from a galvanized iron cable, which is carried in a conduit with an inside diameter of 5 ins., under the center of the track. There are connections to the surface every 9 ft. by which the current is conducted to stud heads laid flush in the pavement. The cable is supported in the conduit, as shown in the section, on a corrugated round insulator, whose shaft extends on one side through the side of the conduit, and is there earthed to prevent any leakage to the contact stud when the latter is supposed to be dead. All longitudinal and vertical joints in the conduit are sealed with bitumen to prevent the entrance of any water. The stud is electrically connected with the cable, when the car passes over it, by means of a plunger which is held by a spring normally away from the iron cable. When the magnets on the car pass over the stud plate, the plunger is magnetically



CROSS-SECTION OF CONDUIT THROUGH CENTER OF STUD, SHOWING SWITCH PIECE DOWN, AND LONGITUDINAL SECTION OF CONDUIT THROUGH CENTER OF STUD, SHOWING SWITCH PIECE UP

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

The skate, or collecting device, on the car consists of a chain



COMPLETED CONDUIT BEFORE FILLING WITH CONCRETE

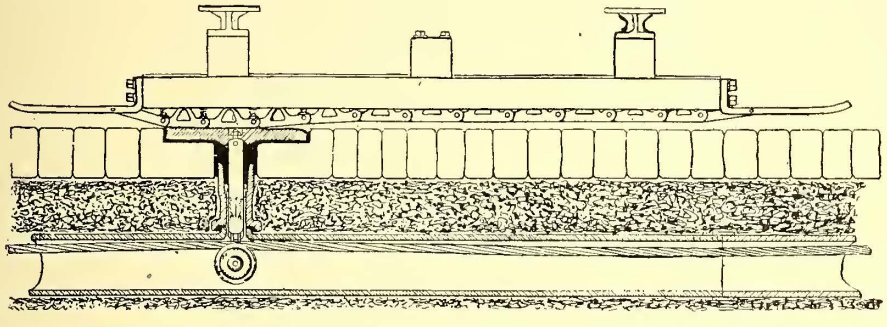
of triangular iron links, as shown in the side view. These links are connected at each end with the electromagnets carried on the car, and when the car passes over a stud head the links move down and make contact with it. After passing a stud, the links are drawn up out of contact with the pavement by

springs. A storage battery of nine cells is used on the car to excite the magnets in case of temporary failure of the source of current supply and in starting the car. The batteries are connected in parallel with the magnets and in series with the motors. It is stated that cars have been run at a speed of 20 m.p.h.

The accompanying views show the details of the system as well as portions of the Lincoln Tramways while under construction. The diameter of the galvanized wire cable in the conduit at Lincoln is 1¼ ins., and the average leakage on the 3 miles of line now in operation is said to be .3 amp. at 500 volts. The Lincoln system has eight double-deck cars equipped with Westinghouse motors and mounted on Brush trucks.

REPORT ON AMERICAN RAILWAYS BY A LONDON OFFICER

A. L. C. Fell, chief officer of the London County Council Tramways, who made a trip to this country during the spring of 1905, has just rendered his report to the County Council. Mr. Fell visited New York, Washington, Pittsburg, Toronto, Buffalo, Boston, Albany and Schenectady. In his general remarks he states that he was greatly impressed with the high-speed interurban electric lines in this country, but also with the poor condition of the street paving in some of the cities visited. This point he thinks should be taken into consideration when comparing the operating conditions with those of similar undertakings in London. In New York and Washington he was very much interested in the conduit system used, but considered that the method of changing from plows to trolley, in Washington, is less convenient than that employed in London and Paris. He noticed single-ended cars in Toronto for the first time, and thought well of the Toronto momentum brake (see the issue of this paper for June 13, 1903), which he proposes testing in London. He also approved of the convertible cars which are used in that city (see the issue for March 12, 1904), but doubted whether the same convertible principle was applicable in London, where the cars are narrower and where only four passengers can sit on a cross seat instead of five as in Toronto. In Pittsburg and Schenectady he inspected the single-phase system. He considers the American system of fare collection and registration crude, but states that in Boston the Railroad Commissioners are now considering the adoption of the ticket system as employed in London. Other features of American practice which he looked upon with favor were schools and recreation rooms for employees and repair shop design.



LONGITUDINAL SECTION OF ROADBED AT LINCOLN, ENGLAND, SHOWING POSITION OF CABLES, CONTACT STUDS, ETC.

Mr. Fell also devotes considerable attention to the subject of rail corrugations, referring to the corrugations on the Boston elevated system, on which corrugations no less than 31 ins. in length and .015 ft. between the top and the bottom of the wave were found. In all other cities visited except Buffalo, corrugations were found in a more or less marked degree, and apparently the length of the corrugation wave increased with the average speed of the cars. He said that the British electric roads also show corrugations varying in length from 2½ ins. to 5 ins., and that the worst corrugations appear at curves, where a short wave is formed on the outer rail and a longer wave on the inner rail. The corrugation at first appears on the outer rail. Similar trouble has been experienced on the Brixton cable road in London, except that the corrugation at the curve started on the inner rail and was transmitted to the outer rail, and that the longer corrugation is on the outer rail and not on the inner. No corrugation has been noticed on horse railways or on steam railways, but it has appeared on steam-driven tramways in England. He states it as his opinion that the unevenness may be due to three causes: (1) Chattering or vibration of the rollers when commencing to roll the ingot into a rail, causing a rough rail surface. (2) Uneven or wide joints between rail ends, rigidly supported on a concrete bed. (3) Jumping action set up in car wheels by variations on the wheel or track gage.

To ascertain if his first theory was correct, Mr. Fell made some tests in the New Cross car shed before the rails had been used in any way by the cars. A long emery block, fitted under a truck, was run lightly over several lengths of track, and a distinct corrugation was noticeable on the rail surface, although in some instances it was not very regular in form. About nine months ago he had a water tank fitted up with a grinding apparatus, consisting of a carborundum block, 10 ins. long x 2½ ins. wide, which could be pressed down on to the running rails. By this means some of the worst corrugations were ground out, and have not yet reappeared. He says that now the corrugation of the rails is becoming somewhat serious on all the sections of the London system, but additional grinding apparatus is being fitted on the new water tank cars, which will shortly be delivered, and he hopes to be able to grind out the waves. Mr. Fell found that no attempt has been made hitherto in America to get rid of the trouble in the manner suggested.

To obviate the trouble, Mr. Fell suggests that with new rails arrangements should be made, if possible, for passing them through a grinding machine after rolling; the corrugations are so slight that very little would have to be done to prevent the trouble developing in a serious manner at a later date.

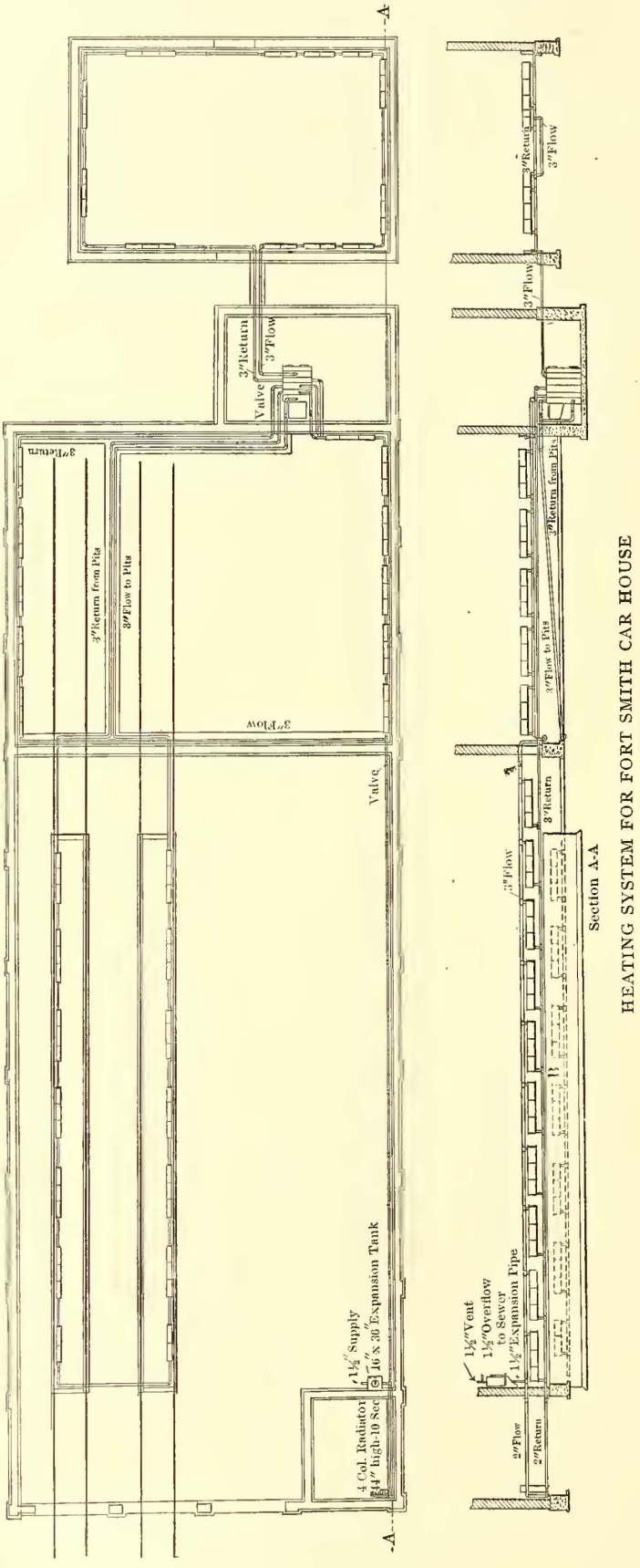
A COURSE IN ELECTRICITY ON THE SOUTH CHICAGO CITY RAILWAY

General Manager George R. Folds, of the South Chicago City Railway, has organized a class composed of employees of the road for the study of electricity. The course is not intended to deal with the operation of cars and other electrical apparatus, but is designed to teach the elementary principles of electricity to all the employees, whether or not they are employed with electrical apparatus. The benefit the company will derive, if any, from the inauguration of the course will be that resulting from the closer feeling of fellowship which will be built up between the employees themselves and between the employees and the officers by meeting together.

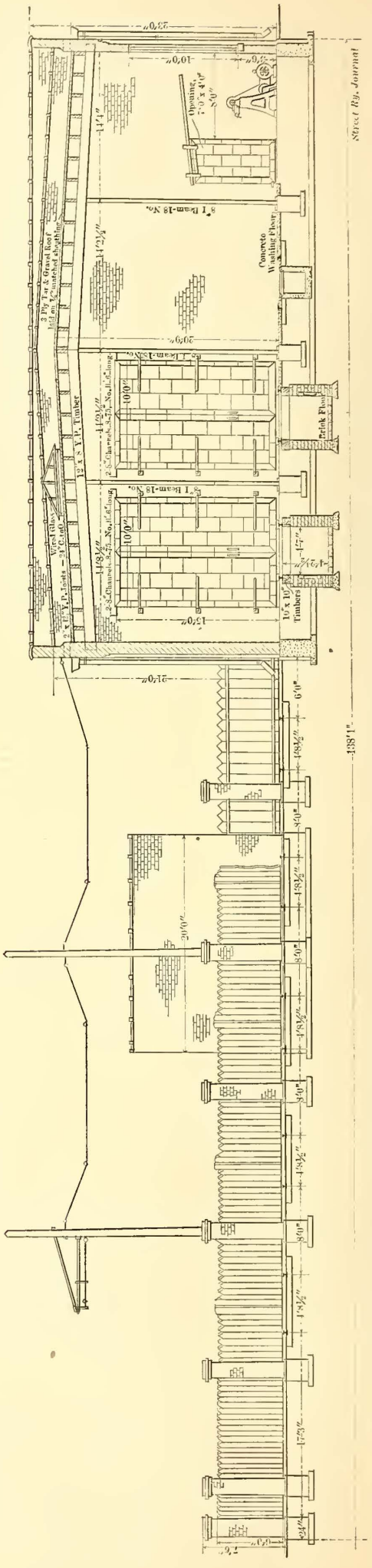
After the course is well advanced, if desired by the employees, special study will be made of street railway electrical equipment, such as controllers, motors and power house apparatus. Different officers of the company serve as instructors. Among the teachers is E. Jowett, chief engineer of the power station. Mr. Folds is well fitted for the task undertaken, as he organized a course of instruction for the Brooklyn Rapid Transit Company when with that company.

THE NEW CAR REPAIR SHOPS AT FORT SMITH, ARK.

The street railway system of Fort Smith, Ark., has undergone a complete reconstruction since it was acquired by H. M. Byllesby & Company, of Chicago, a little more than a year ago. The power house has been rebuilt and enlarged, the lines

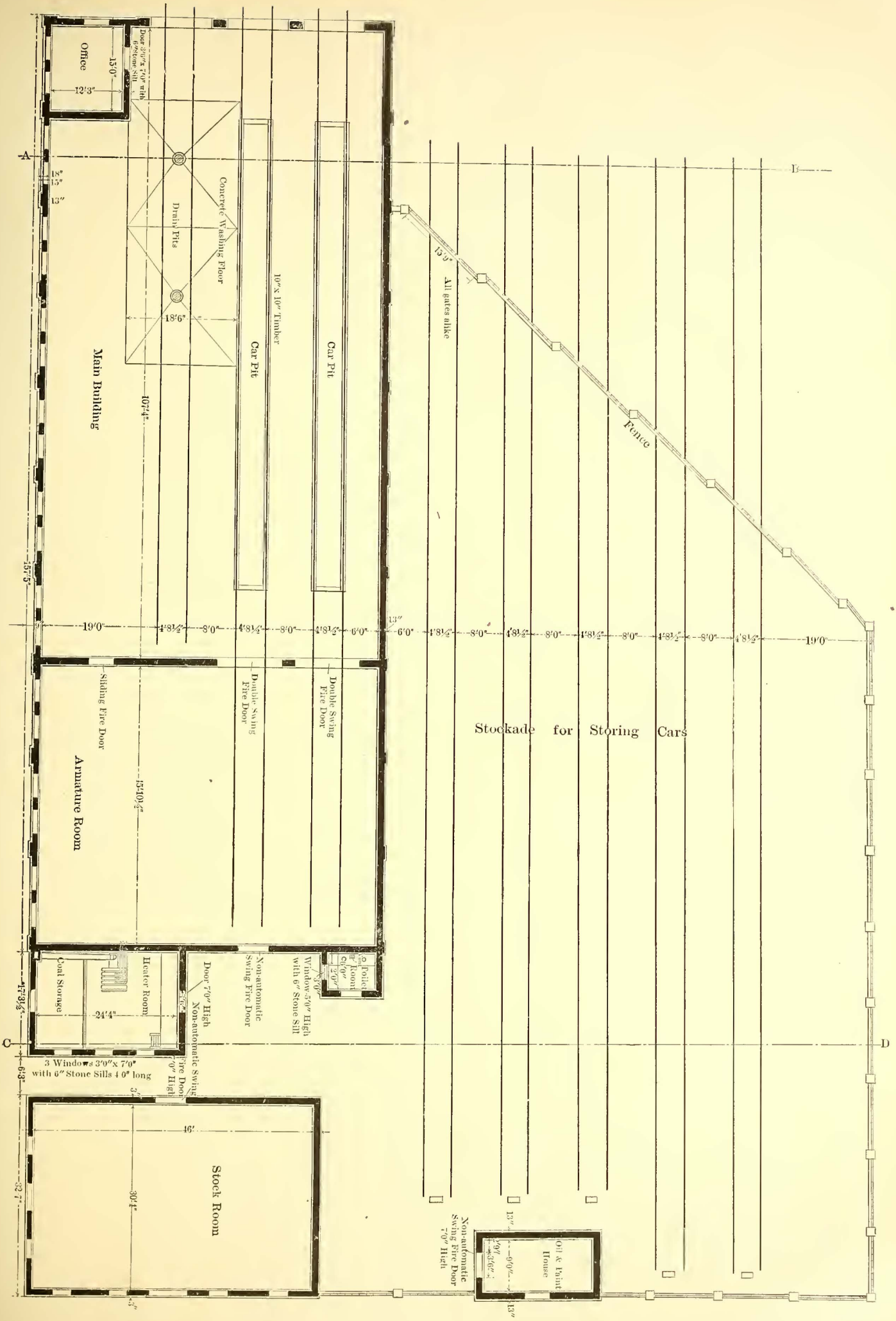


HEATING SYSTEM FOR FORT SMITH CAR HOUSE



SECTIONAL ELEVATION THROUGH FRONT OF NEW CAR HOUSE AT FORT SMITH, ARK., SHOWING REPAIR SHOP AND STORAGE STOCKADE

extended, a pleasure park containing more than 100 acres opened up and other improvements tending to put the system on a well-paying basis have been inaugurated. Of the new features, the shops recently erected to care for the equipment



PLAN OF CAR HOUSE AND STORAGE STOCKADE AT FORT SMITH

contains many interesting features. They are not, to be sure, as completely equipped as shops for larger systems, yet they are deserving of a description of some length because of the fact that in their design all the requirements of shops for a small system were considered and well worked out.

One of the main points kept in mind in the design of the shops was that they should be as nearly fireproof as possible with a reasonable outlay of money. A special point was made of reducing the risk of losing cars by fire and also of reducing the cost of insurance on cars, and to this end no provision was made for storing cars indoors. A stockade built along one side of the shops serves as a storage yard. In addition to the main shops, there has been erected in the immediate vicinity a storeroom and an oil house.

The main repair shop is a brick structure measuring 175 ft. 5 ins. x 58 ft. 4½ ins. The foundations, which are of concrete, rest on a bed of hard-packed sand.

The roof is of slow-burning mill construction, being supported through the middle of the building by 8-in. I-beams extending from the floor. Yellow pine timbers, 8 ins. x 12 ins., support a joist measuring 2 ins. x 12 ins. and placed with centers 24 ins. apart. These joists, in turn, carry ⅞-in. tongued and grooved sheathing covered with 3-ply tar and gravel roofing. As a further protection against fire, the wall of the building alongside the stockade is a fire wall, being without windows. To properly light this side of the building, on this account it was necessary to place skylights in the roof. These are of ample dimensions and are glazed with wire factory glass.

The interior of the building is divided into two sections by a fire wall. The wall extends up above the roof of the building, the openings through it being provided with automatic fire doors.

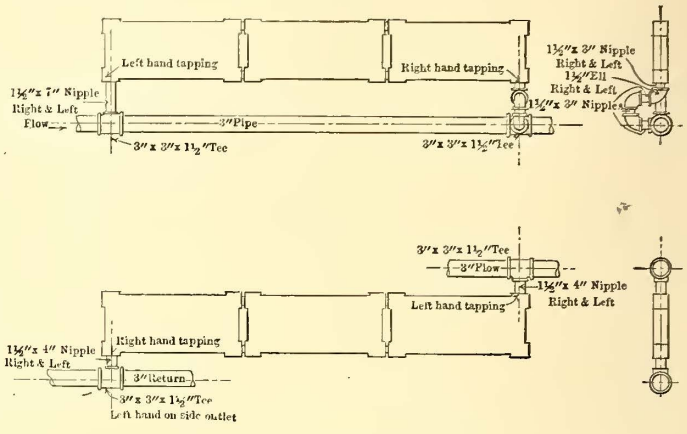
The rear portion is used as a paint shop and winding room, while the larger of the two rooms serves as a general repair shop. In addition to two repair tracks, which extend the full length of the building, this room contains a track devoted entirely to the washing of cars. The concrete floor under this section slopes to two sinks which are provided with drains. Under each of the repair tracks pits are provided, the brick walls of which rest on concrete foundations. The walls support 10-in. x 10-in. stringers, and upon these the rails are spiked.

The shop is well supplied with machine tools. These are all located along that wall of the building opposite the storage yard, the list including a hydraulic wheel press, boring mill, lathe, drill press, emery grinder and other minor tools, all driven through a countershaft by one motor.

An ideal sectional water-tube boiler located in a small attached brick structure in the rear of the shops, supplies the necessary heat to the building. Radiating sections are used instead of the usual pipes for heating the main portion of the shops. These are located along the walls under the windows. The pits are heated by an independent circuit, thereby permitting the heat to be turned on or off the pits independently. It is thought heater pipes as usually installed in car-house pits are objectionable, because the pipes are so exposed that they are frequently torn down or caused to leak by heavy repair parts falling on them from above. One of the accompanying drawings shows the method of installing the radiating sections in the pits, the recesses in the pit walls shielding the sections from injury. These sections were also used in preference to the usual piping because of the lessened total expense.

The storeroom located in the rear of the shop is somewhat larger than would be required for street railway supplies alone, and it will be used for electric light and power house supplies as well. The oil storage house is a brick structure located some distance from the main shop. Ventilators are built into the walls of the building, as may be observed by reference to one of the drawings.

The yard in which the cars are stored is surrounded by a stockade. At intervals of about 12 ft. brick posts, 18 ins. square, are built, and these relieve the otherwise monotonous appearance. The stockade contains four tracks. The trolley wires over four of these are supported by spans between two



DETAIL OF RADIATOR CONNECTIONS FOR HEATING SYSTEM AT FORT SMITH CAR HOUSE

lines of poles. The wire over the fifth track is carried on spans attached at one end to one line of poles, and at the other to brackets on the side of the building. The peculiar shape of the stockade was rendered necessary because of the proximity of the street in front, which runs diagonally with respect to the general direction of the walls of the shop.

Two fire hydrants are located at convenient points within the enclosure. These, as well as those within the building, will be connected to the city water system.

Passing immediately in front of the shops is the double-track line of the system leading to the ball park and to Electric Park, an amusement resort located on the Arkansas River. In order to prevent interference with cars on the main line, all the tracks from the shop and storage stockade lead to a set of double tracks running parallel with the main tracks, and these in turn lead to the main tracks.

When set in the yards, the cars are placed 10 ft. apart. Heavy tarpaulins are provided, and during inclement weather the cars will be covered. The tarpaulins used are of sufficient size to cover a 25-ft. or 30-ft. car, and cost $65 apiece.

O. E. Osthoff, vice-president of the firm of H. M. Byllesby & Company, under whose direction the shops were designed, states that the total cost of the plant was approximately $18,000.

CURIOUS ACCIDENT IN COLUMBUS

On Jan. 6 a car of the Columbus Railway & Light Company, of Columbus, Ohio, eastbound on West Broad Street, was stopped by a work car ahead, bound in the same direction, which had blown a fuse. A passenger, James Nusbaum (an ex-employee of the company), became impatient at the delay, went to the forward doors leading into the vestibule, and remonstrated with the motorman. The motorman politely requested Nusbaum to step inside the car, which he did, and the motorman closed the doors. Nusbaum resented this action by pulling the doors open again and berating the motorman, who shut the doors on Nusbauin's nose. Not being satisfied with the information he received when he called at the office of the company, Nusbaum had a warrant issued for the motorman's arrest on a charge of assault and battery. At the trial it was shown that the motorman had no intention of assaulting him, and in fact did not assault him, and the case was dismissed. B. B. Davis, claim adjuster for the company, says he never heard of a case of this kind before.

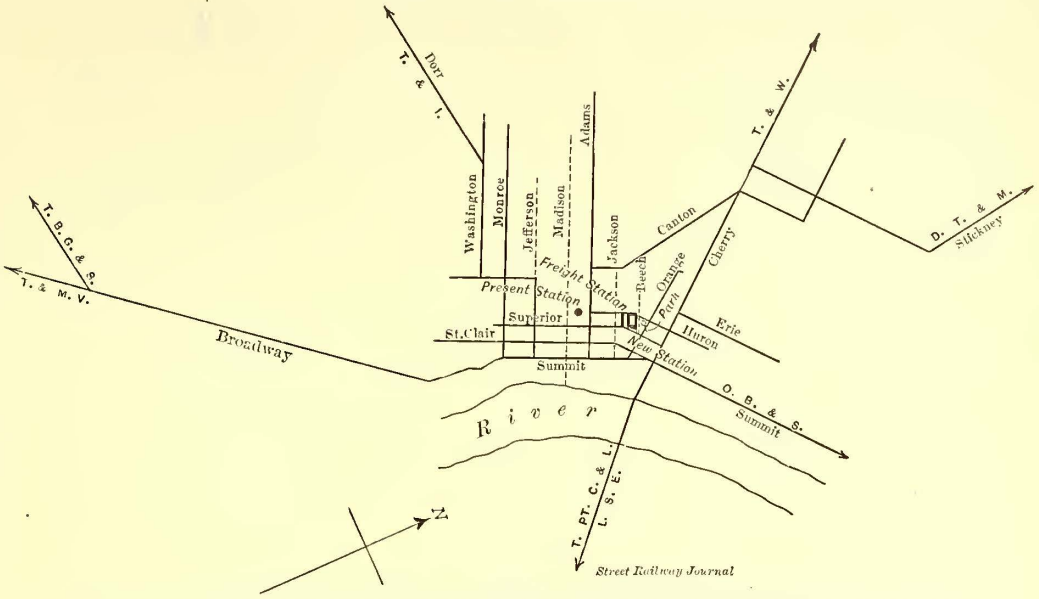
NEW UNION STATION FOR TOLEDO

Work has been started on the new interurban union station at Toledo. The building will be owned and operated by the Toledo Railways & Light Company, and will be utilized by the seven roads entering that city. It will be located at Beech, Huron and Superior Streets, with a frontage on the first-named street of 342 ft., 125 ft. on Huron Street and 125 ft. on Superior Street. Following the plan adopted for Indianapolis, it will include an office building, with a separate train shed. It will be a flexible layout, as the ground space owned by the company provides room for another train shed of the same size, while the office building portion, at present designed to be three stories high, will have walls of sufficient strength to support three additional stories.

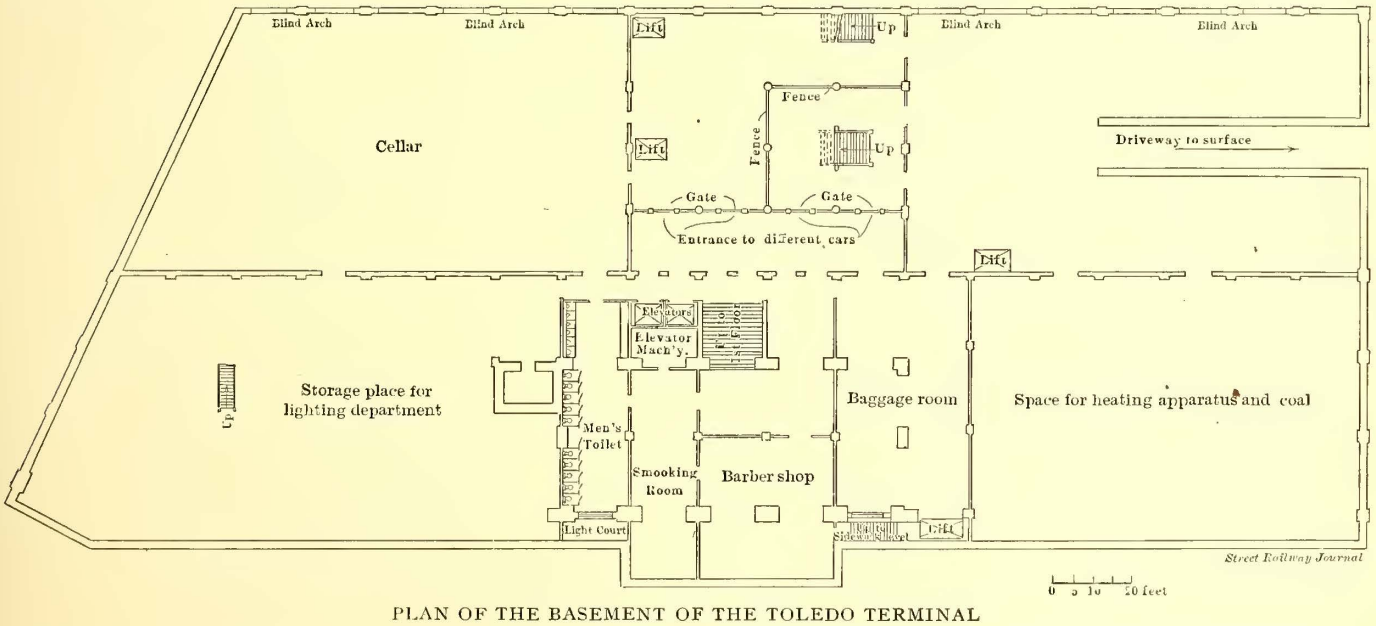
The building will be of fireproof construction, with steel frame work and brick and porous fireproofing. It will face a small public park, and the front will be of ornamental design. A 16-ft. arcade will run through the center of the building from Huron to Superior Streets, parallel to the tracks, providing entrance from these streets, while the main entrance will be on Beach Street through three large double doors opening into the main waiting room, 50 ft. x 85 ft. This room will be two stories high. Adjoining this on either side will be check and lunch rooms, a news stand, ticket office and ladies' rest room. The Beech Street front will contain eleven stores, and one corner of the building and half of the basement will be utilized by the company for its lighting department. The company's general offices will be above. In the basement beneath the waiting room will be a men's smoking room, toilet rooms, barber shop and a large baggage room. An incline roadway will reach the baggage room and large basement from the Huron Street side. Trunks and baggage will be elevated to the tracks or to the sidewalks on the Beech Street front by lifts, so that all loading and unloading of baggage in the station proper will be eliminated.

There will be four tracks in the train shed, each 340 ft. long. One of the most interesting features of the station will be an arrangement that will avoid the crossing of the tracks in the train shed by passengers. Cars will enter from either Huron or Superior Streets, both of which have double tracks. Cars for tracks Nos. 1 and 3 will enter from the Superior Street side, while those for Nos. 2 and 4 will enter from Huron Street. Between tracks 1 and 2 and between 3 and 4 will be a narrow devil's strip just wide enough for the cars to pass, while the space between 3 and 4 will be the same width. Between these tracks will be railings extending the full length of the building. The Toledo cars are nearly all single enders, and load and empty from one side. Passengers for track No. 1 will enter directly from the station floor, but those for Nos. 2 and 3 will pass down a flight of stairs, through a passage under the tracks, and up to a wide platform. Passengers for track No. 4 will pass beyond to a similar stairway and to a platform beyond No. 4 track. The various roads will always use the same track, and announcers will designate the proper track. There will be no posts in the station, eliminating another prolific source of accidents. As intimated, the trackage space and train shed can be increased 100 per cent without changing the plan of operation in the least.

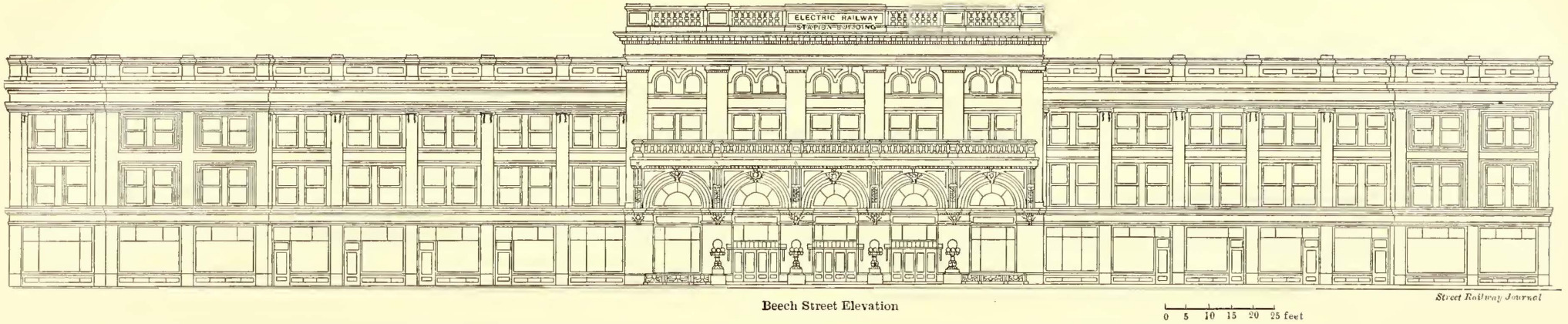
The location of the station is about one block north of the



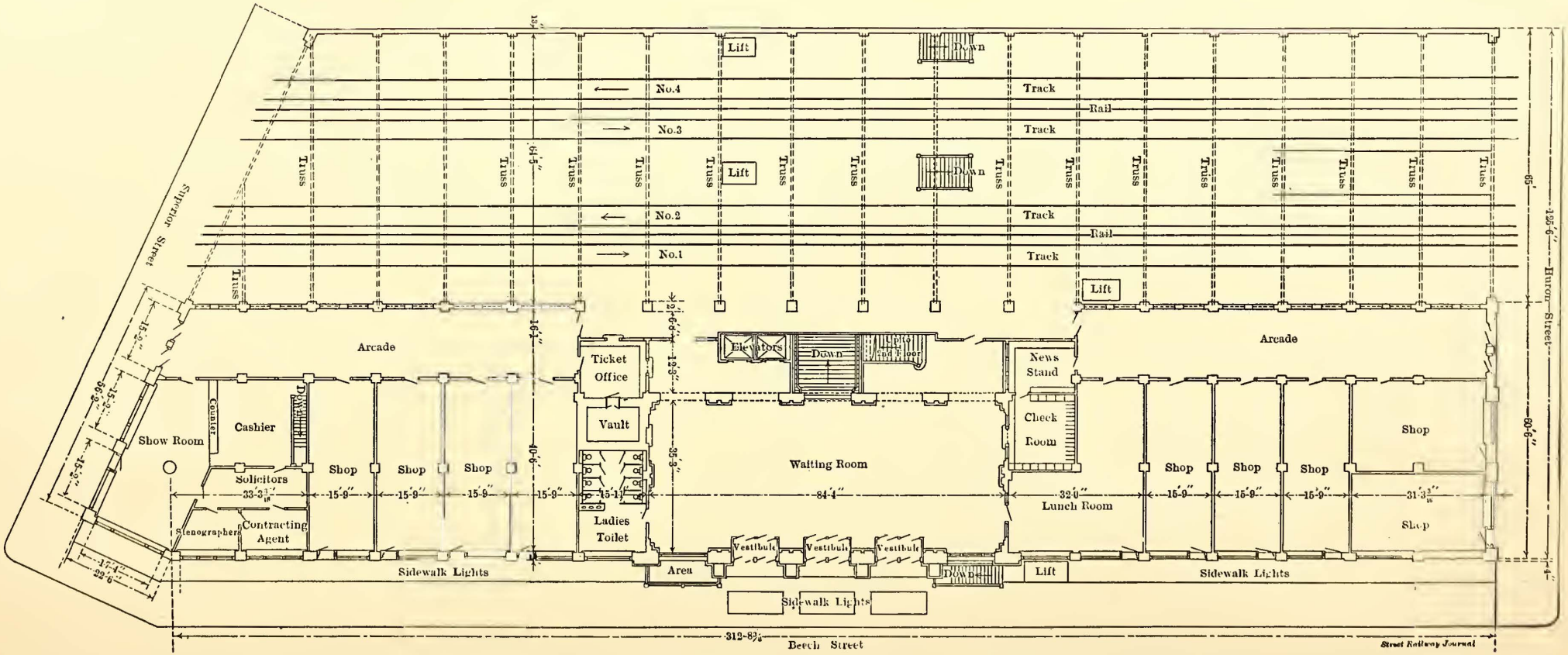
PLAN, SHOWING THE LOCATION OF THE TOLEDO TERMINAL AND THE CONNECTIONS WITH THE ENTERING INTERURBAN ELECTRIC RAILWAYS



PLAN OF THE BASEMENT OF THE TOLEDO TERMINAL



FRONT ELEVATION ON BEECH STREET, TOLEDO, OF THE NEW ELECTRIC INTERURBAN RAILWAY TERMINAL STATION



PLAN OF THE FIRST FLOOR OF THE TOLEDO ELECTRIC INTERURBAN RAILWAY TERMINAL

present waiting room at Superior and Adams Streets, and it immediately adjoins the present freight station of the interurban companies. The Toledo Railways & Light Company owns the entire block with the exception of a small piece, and there is ample room for large extensions to the freight station as well as to the passenger station. It is two blocks north of the corner of Superior and Madison Streets, the business center of the city. This removes it somewhat from the most congested district, yet leaves it very near to the shopping and wholesale districts. From an operating standpoint, it is much more advantageous to both the interurbans and the city company than the present waiting room at Superior and Adams Streets. At present the cars traverse the loop formed by Superior, Jefferson, St. Clair and Adams Streets, which is the most congested district in the city, so much so that the city cars are greatly delayed by the loading and unloading of the interurbans, and the latter cannot lay up for a second at the waiting room. Under the new arrangement, the interurbans will use the lop formed by Superior, Cherry and Huron Streets and the station building. As will be seen from the accompanying plan of the business section of the city, the number of interurbans in the congested district will be greatly reduced and there will be no stopping of these cars in that district. The plan of having the freight and passenger stations close together will be an added convenience. Several of the roads handle express and baggage matter in combination cars, and these cars must run to the passenger station to unload passengers and then to the freight station two blocks away for the other matter. Passengers are also obliged to go to the freight station for their baggage, and frequently through connections are missed by the time lost in going from one building to the other.

Altogether the station will be of immense advantage to all concerned. The plans presented are merely the preliminary ones, and many of the details are yet to be worked out. The station will be owned outright by the Toledo Railways & Light Company, and the interurbans will have no interest or management in the enterprise. The contracts for the use of the station have not yet been worked out, but it is understood that the plan will be similar to that adopted for Indianapolis. It may be slightly different, however, owing to the fact that while the Toledo interurbans divide the city fare with the city company, they have a sliding scale, beginning with 1 cent and 4 cents and running down to 2½ cents and 2½ cents after a long term of years.

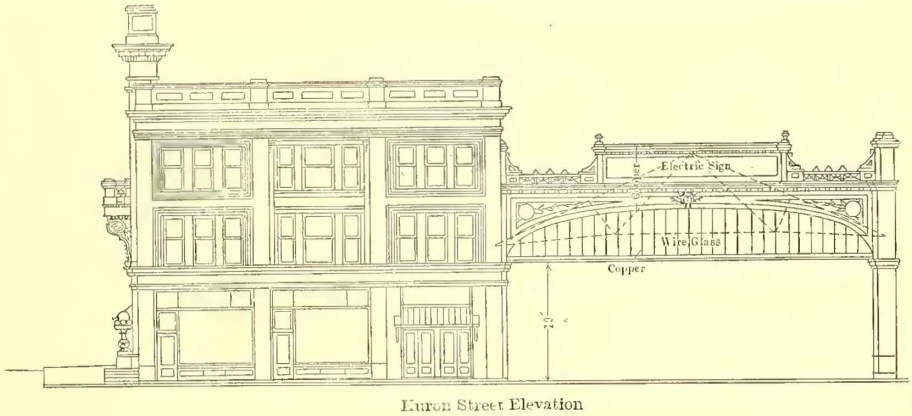
It is stated that the building will cost about $200,000. Plans were prepared by Bacon & Huber, of Toledo, under the supervision of L. E. Beilstein, vice-president and general manager of the Toledo Railways & Light Company.

RECORD OF THE EFFORT TO LIMIT CAR-CARRYING CAPACITY IN CLEVELAND

About two weeks ago the city authorities of Cleveland ordered the Cleveland Electric Railway strictly to enforce the provisions of the health code, which provides that cars shall not be loaded to more than one and a half times the seating capacity. The company has since tried to enforce the law, but its efforts have been largely ineffective. The company declined to instruct its conductors to use force to eject passengers above the limit, but cars have been run past people when the capacity set by the ordinance was reached. As a result, many men have jumped on the cars while in motion, and there has been more than the usual number of accidents. A large number of additional trippers were placed on the various runs, but this only served to increase the congestion of cars in the Public Square district, and the movements of passengers were slower than before. Public sentiment is plainly against the move, but the city authorities insist upon enforcing the law. Finding protests in vain, the company secured permission from the city to divert a number of its lines from the Public Square by means of new downtown loops, and on Tuesday, Jan. 23, began to operate under the new plan. The company is thus enabled to take 175 cars an hour off the Public Square during the heaviest rush hour. Protests have been lodged against change of routes, however, as many persons are compelled to walk two or three blocks to transfer in the downtown district. Another annoying feature is that the change diverts some of the interurban lines away from the square, and they are no longer able to utilize the union waiting station and layover terminal.

IMPROVEMENTS IN SEATTLE

Improvements extending to nearly every department of the system are to be made this year by the Seattle Electric Company. Perhaps the most important work planned is proposed for the power supply and the operating departments. The company has purchased a large tract of land just south of Seattle, on which it expects to begin this year a nucleus for a considerable shop and storeroom installation, including car house for housing a portion of the cars of the city system, and also cars and trains of the Puget Sound Electric Railway. The company also expects to begin the construction on the same land of a power station as an additional steam relay to its water-power supply, and will probably install at first a 3000-kw turbo-generator, with boilers and auxiliary machinery, the plan contemplating the beginning of a building which can be extended ultimately to aggregate 30,000 kw.



HURON STREET ELEVATION OF THE TOLEDO TERMINAL, SHOWING THE ENTRANCE TO THE TRAIN SHED

A number of extensions to existing lines also are contemplated, but the location and extent depend somewhat upon local conditions, and are not yet fully determined. The company will, however, complete the construction of the Fremont Avenue extension from the Fremont railway crossing over Fremont Avenue and other streets to the west side of Woodland Park, and will build an extension to the University line through Ravenna Park and on to Calvary Cemetery. Double tracks are now being laid in First Avenue south from the East Waterway to Spokane Avenue.

The company expects to add to its city equipment twenty-five 30-ft. body, four-motor electric cars, and will build in its own shops two combination open and closed grip cable cars for the Madison Street cable line. In connection with the city, in streets where there are tracks, a considerable amount of relaying of light rail with heavy rail and paving will be done.

POWER PLANT ECONOMICS *

The author began his paper by a brief reference to the changes which were being introduced in power station practice by the development of the steam turbine, and how this had in turn reacted favorably upon the development of the reciprocating steam engine, as well as the internal combustion or gas engine. He wished to direct attention to the basic fact that in power plants one should not look merely for increased efficiency in the prime mover, but should also investigate and analyze the entire plant from the coal to the bus-bars: first, in regard to efficiency; secondly, in regard to the effect of load factor upon investment; and thirdly, the effect of the first and second upon the total cost of producing the kw-hour, which is the ultimate test of the skill of the designer and operator.

In taking up the question of efficiency, Mr. Stott presented the accompanying Table I., which gives a complete analysis of the losses found in a year's operation of what is probably one of the most efficient plants in existence to-day, and therefore typical of the present state of the art:

TABLE I.—ANALYSIS OF THE AVERAGE LOSSES IN THE CONVERSION OF 1 LB. OF COAL INTO ELECTRICITY

	B.T.U.	Per Ct.	B.T.U.	Per Ct.
1. B.t.u. per pound of coal supplied.	14,150	100.0	.....	.....
2. Loss in ashes	.....	.....	340	2.4
3. Loss to stack.....	.....	.....	3,212	22.7
4. Loss in boiler radiation and leakage	.....	.....	1,131	8.0
5. Returned by feed-water heater....	441	3.1	.....	.....
6. Returned by economizer.....	960	6.8	.....	.....
7. Loss in pipe radiation.....	.....	.....	28	0.2
8. Delivered to circulator.....	.....	.....	223	1.6
9. Delivered to feed pump.....	.....	.....	203	1.4
10. Loss in leakage and high-pressure grips	.....	.....	152	1.1
11. Delivered to small auxiliaries.....	.....	.....	51	0.4
12. Heating	.....	.....	31	0.2
13. Loss in engine friction.....	.....	.....	111	0.8
14. Electrical losses	.....	.....	36	0.3
15. Engine radiation losses	.....	.....	28	0.2
16. Rejected to condenser.....	.....	.....	8,524	60.1
17. To house auxiliaries	.....	.....	29	0.2
	15,551	109.9	14,099	99.6
Delivered to bus-bar.....	1,452	10.3		

In discussing the various items in detail, the author mentioned a CO_2 recording instrument recently placed on the market. He presented the results of a series of tests made with this instrument, and spoke of the improvements made toward reducing the stack losses by thus watching the CO_2 record.

Mr. Stott believed that by carefully watching each source of loss the present type of power plant using reciprocating engines can be improved in efficiency as follows: Reduction of stack losses, 12 per cent; reduction in boiler radiation and leakage, 5 per cent; and reduction in engine losses by the use of superheat, 6 per cent. This would result in a net increase of thermal efficiency of the entire plant of 4.14 per cent, and bring up the total thermal efficiency from 10.3 per cent to 14.44 per cent.

The author presented a typical economy curve of a steam turbine, which showed that the best economy on dry saturated steam is practically equal to that of a reciprocating engine, and that 200 degs. superheat reduces the steam consumption 13.5 per cent. The shape of the economy curve, however, is much flatter than that of the reciprocating engine, so that the all-day efficiency of the turbo-unit would be considerably better than that of the reciprocating engine, with the other great advantage of costing approximately 33 per cent less for the combined steam motor and electric generator.

* An abstract of a paper presented by Henry G. Stott at the 203d meeting of the American Institute of Electrical Engineers, New York, Jan. 26, 1906.

The inherent principles involved in the design of the steam turbine show that it can be expected to give an almost perfect adiabatic expansion, as there are no thermal cycles of heating and cooling at every stroke as in the reciprocating engine; there is an almost ideal thermal drop from the steam valve to the condenser. It is also evident that the expansion will be relatively more nearly adiabatic in the low-pressure stage of the turbine than in the low-pressure cylinder of the engine, so that it has been proposed that the reciprocating engine should be run high pressure where relatively it is more efficient than the steam turbine, utilizing the turbine for the low-pressure part of the cycle. In other words, use each where it is most efficient. This turbo-unit would be interposed directly between the exhaust nozzle of the reciprocating engine and the condenser, and would have no valves or governing mechanism whatever. The generator would be connected directly to the other generator leads without any switching apparatus, except possibly knife switches to disconnect for testing purposes; and in operation no attention whatever would be required beyond the ordinary lubrication of bearings. Such a unit it is evident could be built at a very small cost per kilowatt.

After summarizing the merits and defects of the gas engine, Mr. Stott mentioned that over a year ago, while watching the effect of putting a large steam turbine having a sensitive governor in multiple with reciprocating engine-driven units having sluggish governors, it occurred to him that here was the solution of the gas engine problem; for the turbine immediately proceeded to act like an ideal storage battery; that is, a storage battery whose potential will not fall at the moment of taking up load, for all the load fluctuations of the plant were taken up by the steam turbine, and the reciprocating units went on carrying almost constant load, while the turbine load fluctuated between 0 kw and 8000 kw in periods of less than 10 seconds. The combination of gas engines and steam turbines in a single plant offers possibilities of improved efficiency, while at the same time removes the only valid objection to the gas engine.

A steam turbine unit can easily be designed to take care of 100 per cent overload for a few seconds; and as the load fluctuations in any plant will probably not average more than 25 per cent, with a maximum of 50 per cent for a few seconds, it would seem that if a plant were designed to operate normally with 50 per cent of its capacity in gas engines and 50 per cent in steam turbines, any fluctuations of load likely to arise in practice could be taken care of.

As the thermal losses in the gas engine jacket water amount to approximately 19 per cent, and as the water is discharged at a temperature above 100 degs., it can be used to advantage for boiler feed. The jacket water necessary for an internal combustion engine will probably be about 40 lbs. per kw-hour, assuming that the jacket water enters at 50 degs. F.; then the discharge temperature will be

$$50 + \frac{19 \times 12{,}500}{40 \times 100} = 109.4 \text{ degs. F.}$$

As the steam turbine will require only about 15 lbs. per kw-hour, including auxiliaries, it is evident that only 37.5 per cent of this heat, or 7.1 per cent of the jacket water loss, can be utilized. The other loss in the exhaust gases of 30 per cent can be utilized either in economizers or directly in boilers or superheaters. Thus by utilizing the waste heat in the gas engines for the purpose of assisting to make steam for the turbines, there can be saved approximately 37 per cent of the total heat lost in the gas engine.

In the summary of analysis of heat balance it was shown that one can reasonably expect to bring the reciprocating engine plant up to a maximum total thermal efficiency of 14.44 per cent, or possibily, with steam turbines using superheat, to 15 per cent.

Referring now to Table I. it will be noted that in item 2 the

loss in ashes was 2.4 per cent, and the loss to stack in item 3 was 22.7 per cent; now with the hot gases from the gas engine exhaust it is evident that the loss in 2 will not exist, and that item 3 will be reduced from 22.7 per cent to about 5 per cent as the process of combustion is completed in the gas engine. The total efficiency of conversion of this 30 per cent of heat from the waste gases when used in the turbine plant would then be 15.0 + 2.4 + (22.7 — 5) = 35.1 per cent.

The heat recoverable from the jacket water was shown to be 7.1 per cent of the total heat in the coal, so that there is 30 per cent + 7.1 per cent = 37.1 per cent of the original heat in the fuel returned from the gas engine, and this can be converted into electrical energy at an efficiency of 35.1 per cent. For each kilowatt delivered by the gas engine plant, 3918 B. T. U. will be simultaneously turned over to the steam plant, and this in turn will give 403 watts to the steam plant free of cost.

The steam plant will then have only to furnish 1000 — 403, or 597 watts per kilowatt at a thermal efficiency of 15 per cent; in other words, the economy of the steam part of the plant will be raised to

$$\frac{15}{0.597} = 25 \text{ per cent.}$$

The average total thermal efficiency of such a combination plant would then be

$$\frac{24 + 25}{2} = 24.5 \text{ per cent.}$$

The interest depreciation and taxes on a plant costing $130 per kilowatt, which may be taken to represent a first-class steam or internal combustion plant, was shown plotted in conjunction with various load factors. Another curve was plotted showing the minimum investment with a plant in which the prime mover would be steam turbines and designed otherwise without regard to efficiency, leaving out economizers, feed-water heaters, etc., and thus reducing the investment to $90 per kilowatt. This cheap and relatively inefficient part of the plant would only be operated on peak loads of two or three hours' duration, corresponding to a load factor of 0.1 or less found in possibly 40 per cent of the output of our lighting plants.

In Table II. will be found a tabulation of the relative values

TABLE II.—DISTRIBUTION OF MAINTENANCE AND OPERATION. CHARGES PER KW-HOUR

	Reciprocating Engines	Steam Turbines	Reciprocating Engines and Steam Turbines	Gas Engine Plant	Gas Engines and Steam Turbines
Maintenance.					
1. Engine room, mechanical...	2.57	0.51	1.54	2.57	1.54
2. Boiler room or producer room	4.61	4.30	3.52	1.15	1.95
3. Coal and ash-handling apparatus	0.58	0.54	0.44	0.29	0.29
4. Electrical apparatus	1.12	1.12	1.12	1.12	1.12
Operation.					
5. Coal and ash-handling labor.	2.26	2.11	1.74	1.13	1.13
6. Removal of ashes	1.06	0.94	0.80	0.53	0.53
7. Dock rental	0.74	0.74	0.74	0.74	0.74
8. Boiler-room labor	7.15	6.68	5.46	1.79	3.03
9. Boiler-room oil, waste, etc.	0.17	0.17	0.17	0.17	0.17
10. Coal	61.30	57.30	46.87	26.31	25.77
11. Water	7.14	0.71	5.46	3.57	2.14
12. Engine-room mechanical labor	6.71	1.35	4.03	6.71	4.03
13. Lubrication	1.77	0.35	1.01	1.77	1.06
14. Waste, etc.	0.30	0.30	0.30	0.30	0.30
15. Electrical labor	2.52	2.52	2.52	2.52	2.52
Relative cost of maintenance and operation	100.00	79.64	75.72	50.67	46.32
Relative investment in per cent.	100.00	82.50	77.00	100.00	91.20

of the various items necessary in the maintenance and operation of a power plant. The first column covers a plant with compound condensing reciprocating engines without superheat, and is derived from a year's record of actual costs of a large plant operating with a load factor of approximately 50 per cent; load factor in this case being defined as

$$\frac{\text{Actual output}}{\text{Maximum hour's load} \times 24.}$$

The values in the other columns have in the main been estimated from the first column, but wherever possible actual data derived from various sources, both domestic and foreign, have been used; but in all cases all values have been reduced so as to make them directly comparable with the first column, and with one another. The values in maintenance and operation of steam turbines are derived from actual costs.

SUMMARY

The present type of steam power plant can be improved in efficiency about 25 per cent by the use of more scientific methods in the boiler room, by the use of superheat, and by running the present types of reciprocating engines high pressure, and adding a steam turbine in the exhaust between the engine and the condenser. At the same time the output of the plant can be increased to double its present capacity at a comparatively small cost for turbines and boilers.

The steam turbine plant has an inherent economy 20 per cent better than the best type of reciprocating engine plant, not so much due to its higher thermal efficiency as to a variety of causes shown in Table II.

An internal combustion engine plant in combination with a steam turbine plant offers the most attractive proposition for efficiency and reliability to-day, with the possibility of producing the kw-hour for less than one-half its present cost.

LIGHTNING PROTECTION*

BY J. V. E. TITUS

It is almost unnecessary to say at the start that however "high flown" claims we manufacturers make in our advertising, a complete solution of the subject of lightning protection has not been made—to date. The progress in this direction, however, during the last few years has been considerable. Heretofore the manufacturer of protective apparatus has had the burden of the proposition on his own shoulders alone. The fact that the subject is receiving so much attention before different societies and associations, such as this one, promises well for the future. It is only by careful co-operation between operating companies and the manufacturer that the most rapid progress is made. It is hoped that the operating companies will give even greater attention to the subject now that they have been properly aroused to the situation that confronts the electric railway industry.

By a process of "natural selection" the practical method of protection has resolved itself to a choice of less than a half dozen forms of lightning arresters. In all of these that have proven popular there is the usual air gap, over which the normal current alone cannot jump, but which offers an outlet to earth for the lightning. When the lightning does bridge this air gap the normal current usually follows. And it is the means provided to stop this flow of normal current that gives us—the manufacturers—our chance to tell you so many conflicting tales about which of these means is the worst.

Some of us try to prevent the normal current following the discharge at all. Some of us try to blow out the arc formed by the normal current, while some try to cut it off by means of "moving parts." There are other ways, each one of which has its pitfalls. We are all pretty well agreed, however, that to have the air gap of the arrester small is of great importance.

* Paper presented at the annual meeting of the Ohio Interurban Railway Association, Jan. 25, 1906.

Therefore, remarks relating to other features will prove of greater interest.

I shall first tell you of some of the recent developments of the research and experimental work carried on by our company in the last few years. This work covers practically all types of arresters on the market at present, but was devoted almost exclusively to the improvement of our own product. As the greater portion of your mileage is operated by direct current of 500 volts to 700 volts, my remarks will be confined to this class of service. With properly designed arresters, properly distributed and with good ground connections, no further precautions than careful inspection at frequent intervals can be taken.

DESIGN

In the design of a lightning arrester there may be all the difference in the world. It has been easy to make one that will discharge a circuit freely. It has been easy to make one that will prevent a continued flow of normal current following the discharge. But to combine both of these features in the same device has been quite a problem.

It is generally conceded that an electric line is a poor place to allow the lightning to linger. Experiments were made, therefore, as to the most efficient method of discharging a circuit. Lightning may be likened to water in some of its characteristics. When it breaks loose it goes with a rush. If you dumped a bucket of water through a straw, a whole lot of it would splash over; if you dumped it through a large enough pipe, you wouldn't spill a drop. It's something like this in a lightning arrester. The path to earth must be as free from resistance as possible. With a high resistance path for the lightning, some of it may splash over and "wet" your machinery or insulation, as the water does if you dump it through a straw. But by making the resistance of a lightning path low, you insure a complete and instantaneous discharge.

Resistance in a lightning arrester may not impede a light static discharge to the extent that it does a sudden rush of current, such as lightning. I believe Alexander J. Wurts, the eminent authority on lightning protection, has said that discharging lightning through a resistance in series with an air gap may be likened to the swing of a pendulum. If an empty glass jar is placed in the path of the pendulum, the glass jar will be broken and the pendulum swing onward in its path freely. But if the glass jar is filled with water, the pendulum will break through the glass as a discharge does the air gap of a lightning arrester, but the speed of the pendulum will be greatly decreased by its passage through the water. The speed, or freedom of passage of the discharge, is impeded by the resistance of a lightning arrester in the same way as that of the pendulum is by the water. Mr. Wurts, therefore, made his famous non-arcing lightning arresters for alternating-current service perfectly free from any resistance aside from that of the air gaps.

The foregoing remarks are completely confirmed by our research work, and will establish the desirability of keeping the discharge path as free from resistance as possible. How this is done will follow in my further remarks. But our observation has been that to keep down the resistance in the discharge path is of prime importance in correct arrester design.

DISTRIBUTION

The distribution of a large number of lightning arresters along the line, in addition to those on each car and those at the station, is rapidly becoming standard practice. Its desirability is apparent for many reasons. Lightning shows a tendency to take the closest and shortest path to earth that it can find, even though it be of high resistance, as shown by the reports from long-distance transmission lines. No arresters are used along such lines, as the development of arresters for such voltages has not yet reached the stage where they can be hung on a pole, unattended, to battle single handed with the most elusive of the elements. As a result, poles are frequently shattered by lightning discharges from the line, as well as direct discharges from the clouds. This is probably due to the inductive resistance of considerable lengths of even perfectly straight wires. This induction tends to drive the discharge through the insulation and the wooden poles to the earth, thus showing most forcibly the tendency of lightning to find an immediate outlet to earth.

By placing arresters sufficiently close together, say every 1000 ft. or closer where storms are very severe, the discharges are offered plenty of proper paths to earth, without endangering the machinery or the insulation. In the event of very heavy discharges, such as frequently occur on long exposed interurban lines, it is almost impossible to have too many arresters. A large number insures each one doing its part of the work, and in this case there is no over-plus to go through the insulation.

The nodal or non-discharge point theory has been well established, and at such points a discharge will not go to earth. The use of a large number of arresters along a line insures a sufficient number of them at points where discharges will occur. Furthermore, when a storm is of long duration and very severe, a certain part of the arrester equipment may be seriously damaged. The more arresters there are on the line, when such a storm begins, the more there will be at its ending. The more arresters used, the less service each one has to perform and the less danger of its being overloaded, which shortens its life.

CONNECTIONS

To insure proper ground connections at all times, we recommend a connection to the rail as well as to a ground point. There are several reasons for this—first of all our own. This is, that the arrester requires a certain flow of normal current to properly actuate the cut-out. If the ground wire is not connected with the rail there may be enough resistance between the rail and the ground point to cut the current down to so small a value that the cut-out will not operate properly. Another reason for the double connection is the probability of the static difference of potential existing between the rail and the earth, or between the rail and the line, particularly if the rail is upon a rock-ballasted roadbed or set in cement or a soil that does not offer a good outlet for the discharge. By grounding to rail as well as the earth, the arrester is placed in a shunt path around the car motors, which affords them the best possible protection under all circumstances. With ground connections to both rail and ground point, any corrosion or breakage of one of these connections will leave the other intact in all probability, thus insuring at all times a good outlet for the lightning.

INSPECTION

A regular inspection and test of all arresters should be made once a month, and additional inspections after severe storms. At such times the discharge points should be observed and cleaned if necessary. Dust and dirt accumulated on the base should be blown away. A small pair of hand bellows is convenient for this work. If any evidence of damage is shown, the arrester should be taken to the repair room for test and overhauling.

Many electric railways are making a practice at the present time of taking down all pole type lightning arresters during the winter months. These are given a careful test in the shop, particular attention being paid to resistance rods, to determine whether or not they have increased in resistance. Any repairs necessary are made in the shop, where they should be, instead of on the line, where the lineman has poor chance of doing careful work.

It is careful attention to the small details of a lightning equipment that brings successful lightning protection, especially if the lightning arresters are of an efficient and durable

design. The fact that we are dealing with such an erratic and practically unknown element should impress us with the need of unflagging effort to have the lightning protective apparatus at all times in first-class condition.

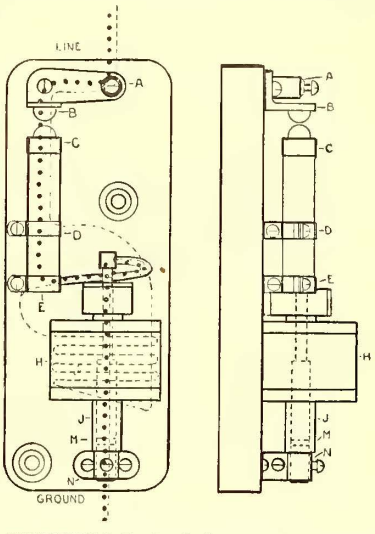
While our experimental work covers many of the different arresters on the market, particular attention is given to our own types, as previously stated. Service results had conclusively shown that while our make of arresters was highly efficient in discharging a circuit, after a season or two of severe storms the number of burned out arresters was disconcerting, to say the least. Arresters that have been burned out are generally so completely wrecked that it is difficult to find enough partially damaged ones on which to base a report of the real cause of the trouble. But careful observation showed that the resistance rods were at the bottom of more than 60 per cent of the burn-outs. The composition of the rods available in past years was principally some combination of graphite or carbon with kaolin, a fine grade of clay, such as used in porcelain. Under the action of lightning, these rods increased in resistance, almost beyond reason; for instance, a rod of 100 ohms would often be increased to 10,000 ohms after a few storms. This high resistance was sufficient to choke back the lightning or force it to find another path to earth, frequently over the surface of the arrester base, resulting in its destruction if the normal current followed this path. This increase of resistance seems to be due to the union of the free carbon and the silicon of the material from which the rod was made. The product of the union caused by the static discharge was a film of something like carbide of silicon or carborundum. This film existing between conducting particles was responsible for the increase in resistance. This weakness of resistance rods has been entirely overcome by making them with a high percentage of metallic conducting materials. The other substances used are carborundum and kaolin, to give strength and stability. The rods now produced by our company are not increased in resistance by the action of the static discharge.

Another cause of burn-out was found to be the arrangement of the parts of the arrester on the base. When dust collected and, later on, moisture due to sudden changes of temperature, the discharge or even the normal current would flash across the base between arrester parts. This formed a short-circuit and soon resulted in the destruction of the device.

To avoid the possibility of such an occurrence the arrester parts have been so distributed on the base that the line connection is at one end and the ground connection at the other extremity, as shown in this diagram. In this way parts of greatest difference of potential are most widely separated. In addition to the arrangement of parts, the method of supporting the resistance rod, as shown in this illustration, greatly increases the distance on the surface of the base between parts of opposite potential. The rod is supported by clamps and brackets *D* and *E*, which gives 2½ ins. surface distance between *B* and *D*. The discharge point *C* is cemented on the upper end of the rod, the other discharge point, *B*, being mounted on an adjustable bracket.

A brief description of the method of operation of this new type of arrester may be of interest. The line connection is at the top of the arrester, as shown. A discharge entering here passes downward in a practically straight path to ground connection. This path is indicated by the heavy dotted line in the diagram. The light dash line shows the path of the normal current. It will be noticed that the discharge goes through the entire length of the resistance rod *C-D*, the normal current being shunted through the solenoid coil *H*. This energizes the iron armature *J*, which raises upward in the coil, opening the circuit between the lower end of the armature and the carbon button *M*, which is connected with the ground binding post *N*. This starves the arc formed at the air gap *B*-C, so that it ceases and the normal dielectric of same is re-established. The coil loses its energy and the armature returns by gravity to its normal position. The arrester is instantly ready for another discharge. As the arc is broken between the iron armature *J* and the carbon button *M*, these two materials cannot stick or weld together; and as the circuit is opened inside the tube and the air-gap adjustment is always the same, it is possible to use the small air-gap standard in this type of arrester, viz., 1-40 in. To limit the flow of normal current that can follow the discharge to ground, the upper section of the resistance rod is used, there being approximately 50 ohms resistance between the discharge point *C* and the clamp *D*. This resistance keeps the current down to a value that is readily broken by the cut-out, and is not enough resistance to impede the passage of the discharge.

It will be noticed that the parts of the arrester are readily accessible from the front. This allows a lineman to inspect, clean or repair the arrester without removing it from its box or the pole.



WORKING PARTS OF NEW LIGHTNING ARRESTER

It has been my endeavor to avoid technicalities in these remarks, as the practical side of the question has resolved itself into the important one. What is wanted is results. To this end comparative tests of different types of arresters should be made in the laboratory as well as in the field. No single laboratory test alone can establish the efficiency or durability of a certain arrester. These tests have been made, however, under all sorts of conditions, and the showing is something like that of the photometric tests of incandescent lamps, made by different salesmen. These tests were certain to show the best results for the lamp the salesman was offering. There are certain test specifications for lightning arresters that must be complied with to give a fair result.

There is in New York City, as you are probably aware, a laboratory that undertakes just such tests. Its standing is of unquestioned character. It seems that its report may be relied upon as beyond appeal. It may, at least, to the fullest extent that any laboratory test can be. The ultimate test of real value is, of course, the one made in service, under widely varying conditions.

I wish to express our appreciation of this opportunity of meeting with you, and would call your attention again to the progress that is possible by the closest co-operation between yourselves and the manufacturers of lightning protective apparaus. To this end I assure you the most willing assistance of our company.

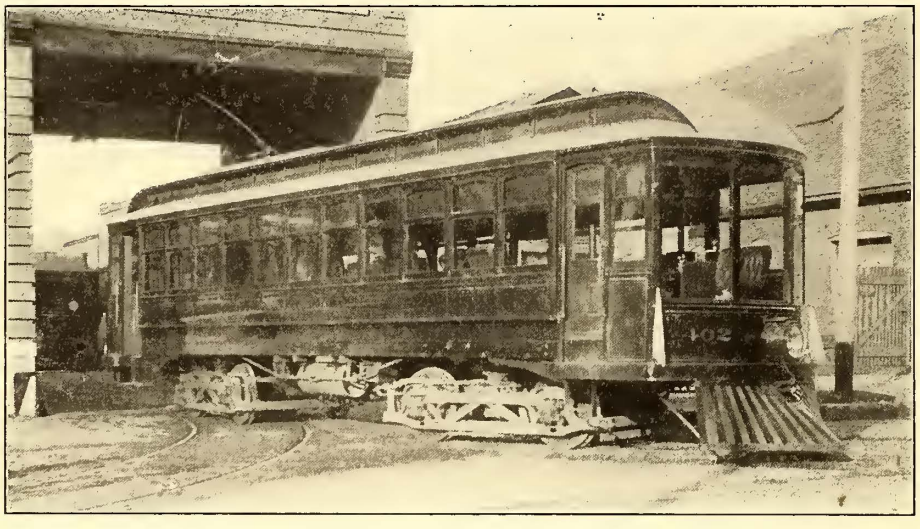
BERLIN PLANS TO TAKE OVER RAILWAY LINES

At a conference of the Berlin municipal authorities Jan. 29 with the municipal officers of eight suburban towns, including Charlottenburg and Schoeneberg, it was resolved to take the initiatory steps to acquire the Berlin Street Railway Company, which has the monopoly of the street railways of Berlin and its suburbs, and to operate roads upon the joint account of the municipalities referred to. The company has a capital of $25,000,000, and its system has been described in previous issues of this paper.

ORGANIZATION OF THE CENTRAL ELECTRIC RAILWAY ASSOCIATION

After two years of usefulness, the Ohio Interurban Railway Association passed out of existence at a meeting at the Algonquin Hotel, Dayton, Jan. 25, and in the evening its successor, the Central Electric Railway Association, formed by the merger of Ohio and Indiana associations, held its first gathering at a magnificent banquet, where the new officers were installed by nearly 300 members, representing not only the two States mentioned, but several adjacent States. The work of the new association will effect the interurban lines of the Central West, and it will be made doubly effective through the establishment of a permanent headquarters and a salaried secretary, who will devote his entire time to furthering the interests of the members.

At the morning session the proposed constitution and by-laws of the new association were read and adopted by the Ohio members, having been previously passed upon by the Indiana Association. It follows closely the plans of the old associations,



PARLOR CAR "LAWTON," OF THE FORT WAYNE & WABASH VALLEY RAILWAY, WHICH CARRIED A SPECIAL PARTY FROM INDIANA TO THE DAYTON CONVENTION

except that the scope is broadened to take in members from adjoining States. Meetings will be held every two months instead of monthly, with an intermission of four months during the summer.

The new officers chosen by nominating committees from both States and ratified at this meeting are as follows: President, E. C. Spring, Dayton, Ohio; first vice-president, C. L. Henry, Indianapolis, Ind.; second vice-president, F. D. Carpenter, Lima, Ohio; treasurer, W. F. Mulholland, Indianapolis, Ind. Executive committee: F. J. Sloat, Hamilton, Ohio; Theodore Stebbins, Columbus, Ohio; Harrie P. Clegg, Dayton, Ohio; J. W. Brown, Connellsville, Pa.; C. N. Wilcoxson, Cleveland, Ohio; W. G. Irwin, Columbus, Ind.; C. D. Emmons, Fort Wayne, Ind.; Gardner Wells, Terre Haute, Ind.; C. C. Reynolds, Lafayette, Ind.; H. A. Nicholl, Anderson, Ind. The selection of the secretary was left open for the first meeting of the executive committee.

At the afternoon session J. V. E. Titus, of the Garton-Daniels Company, Keokuk, Iowa, read a paper on "Lightning Arresters." This paper is published elsewhere in this issue.

George Whyshall, of the Columbus, Delaware & Marion Railway, took exceptions to the plan of taking down lightning arresters in the fall. He said that one of their most severe thunder storms occurred only a few weeks ago, and that they would have been seriously damaged had all the lightning arresters been down.

Mr. Titus explained that he had not intended to convey the idea that all the arresters should be taken down at once. His idea was to remove every third or fourth arrester and inspect and replace it as rapidly as possible, so that all the arrester equipment would be in first-class order in time for the spring storms.

Asked as to the best method of grounding an arrester, Mr. Titus recommended driving a pipe into the ground, reaching moist earth, and said that the pipe should be carried up the pole 8 ft. to 10 ft. to prevent malicious damage to the wire. A brass cap should be placed over the pipe and carefully soldered to prevent induction, which would tend to impede the discharge. For station arresters, he advocated a large copper or cast-iron plate embedded in charcoal.

Mr. Whyshall said their station was built on rock with a dry soil 4 ft. or 5 ft. deep. In order to secure a good ground, they drilled several holes 25 ft. to 30 ft. deep and 100 ft. apart. They inserted in these holes a 30-lb. rail, surrounded by several copper wires, and a considerable amount of pulverized coke was poured into the holes.

J. A. Bendure, of the Toledo & Lima Traction Company, said that too many workmen simply wound a wire around a pipe and called it a ground. They had trouble for a time with lightning arrester grounds, which he finally remedied by digging to moist ground and inserting a copper plate 1 ft. square and ½ in. thick, and driving to this an iron pipe. The pipe was filled with charcoal, and during dry weather they frequently pour water into the pipe. For five years they have had no trouble.

Theodore Stebbins, of the Appleyard system, recalled the early days when a severe lightning storm frequently resulted in burning out all the car motors. He thought that this had been remedied largely by the use of better insulation. He thought that the term lightning arrester was a misnomer, as the function of the device was to divert, not to stop the discharge.

F. J. Sloat, of the Cincinnati Northern Traction Company, thought that troubles frequently arose from grounding to the rail. Some grounds of this kind on their road had been tested and found faulty and had to be changed.

The handsome banquet hall at the Algonquin was beautifully decorated for the first session of the Central Electric Railway Association. Back of the toastmaster's seat was a large floral emblem bearing the words "Ohio and Indiana."

President Spring opened with an address of welcome. He referred to the successful history of the Ohio Interurban Railway Association during the previous two years, and to the effective way in which the administration had been supported by the executive committee and by the different members. He mentioned the introduction of the interchangeable coupon book, the creditable work of the secretary, Mr. Coen, and the valuable assistance rendered by Mr. DeWeese while treasurer. As president of the Ohio Association, he extended the right hand of fellowship to the Indiana members, and as chairman of the joint committee which was appointed by both associations to carry out the amalgamation, he congratulated both States upon the unanimity of purpose exhibited by the committee. He referred to the extensive system of interurban electric lines which had been built up in the States represented by the new association, and which represents an invested capital of $300,000,000 and about 4500 miles of interurban track. He urged all the members to make arrangements so that so far as possible the heads of all the various departments should attend the future meetings of the association. He referred to the honor

which he felt in being elected to the office of president of the new association, and believed that the maxim of the members should be that expressed by Admiral Nelson before the Battle of Trafalgar, that every man should do his duty. If every member should see to it that he gives his work and his interests toward shaping the best future of the association, even greater results may be expected than have been experienced in the past.

The guest of honor, W. Caryl Ely, of Buffalo, president of the American Street and Interurban Railway Association, gave a stirring address on matters of vital importance to the work. Mr. Ely referred to the spirit of hearty accord and co-operation which seemed to be universally manifested in the association, and congratulated the members on this spirit. He advocated a policy of publicity in street railway corporate affairs, and believed that the better the general public understood the electric railway business and the conditions under which it is done, the fairer will be their treatment of this important industry. He mentioned various reforms which were urgently needed, as in connection with long-term franchises and transfers, and advocated the repeal of the law which compels a company to issue as much capital as is represented by its mortgage bonds. This, he thought, leads to overcapitalization. He also believed in the appointment by the Legislature of a Board of Railroad Commissioners, and advocated a broadening of the powers of the Interstate Commerce Commission.

F. W. Coen, the retiring secretary, read letters of regrets from invited guests who were unable to be present, among them Herbert H. Vreeland, of New York; Gen. Bancroft, of Boston; T. E. Mitten, of Chicago; Frank W. Hoofer, of Denver; Henry A. Everett, of Cleveland; W. Kelsey Schoepf, of Cincinnati; Gov. Hamlin, of Indiana, and Gov. Patterson, of Ohio.

President Henry, of the Indiana Association, was the next speaker. He spoke of the work accomplished by the two associations, giving credit to Ohio for inaugurating the movement. He urged close co-operation and strenuous action for the new association. He said that the interurban roads were close to the hearts of the common people, and that so long as they catered to the wants of this class they would secure all the concessions that were right. He invited all to attend the next meeting to be held at Indianapolis, March 22.

Harrie P. Clegg, of Dayton, made a most humorous address. In closing, he referred to the valuable services rendered to the Ohio Association by President Spring, and then presented Mr. Spring with a beautiful silver and glass decanter, the gift of his associates in the association.

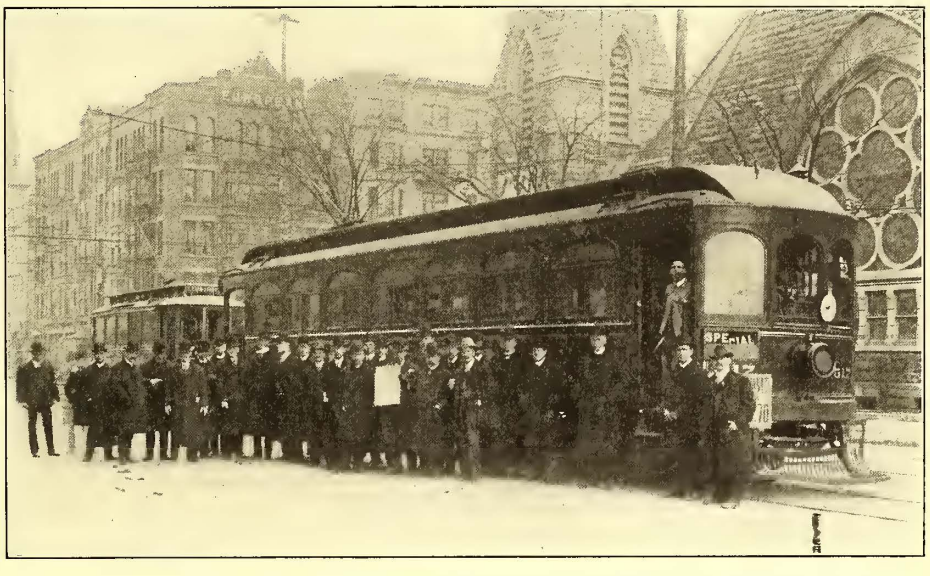
Henry W. Blake, editor of the STREET RAILWAY JOURNAL, said that the gathering marked an important epoch in the history of electric traction. Ohio and Indiana had been leaders in the early developments of the industry, and at present surpass other States in the mileage of their interurban lines. Their practice on matters of equipment, train despatching, block signal systems, freight development, etc., and the future work of the new association will be watched with vital interest, not only throughout this country, but all over the world.

T. Russell Robinson, of the Boston Industrial Company, spoke of the differences between the so-called interurban lines of New England and those of this district. He expressed himself as amazed at the long distances covered, the speed of cars and the character of the equipment. He advocated the need of a State Railroad Commission in Ohio.

Judge C. W. Riley, of Detroit, followed with a bright picture of the future that awaits traction lines, which he thought would soon supersede steam lines in the short-haul business. He deprecated the efforts of some roads to secure long-haul freight business, and advised that they stick to the passenger business, making good and frequent service the paramount aims.

Bernard V. Swenson, secretary of the American Street and Interurban Railway Association, said that the success of the new association depended upon organization and co-operation. He thought that the new association should co-operate with the national organization, and he outlined the work and plans of the national secretary's office.

J. Sprigg McMahon, of Dayton, attorney for several of the roads, suggested that traction attorneys be invited to attend meetings of the association and hold a small gathering of their own to discuss legal matters. He urged that immediate steps be taken to appoint a legislative committee to investigate measures now before the Ohio Legislature, a number of which he characterized as most detrimental to traction interests. He spoke of one bill which provides that all grants by municipalities shall be referred to the people to be passed by vote. This, he said, would result in endless delays in matters of changes and improvements, which are of no consequence to the people, but important to companies. Another undesirable bill provides that roads shall be taxed according to the market value of their securities instead of being assessed by county boards.



ATTENDANTS AT THE DAYTON CONVENTION, WHO ARRIVED ON THE SPECIAL CAR OF THE DETROIT, MUNROE & TOLEDO RAILWAY. THIS CAR COVERED 720 MILES IN GOING TO AND RETURNING FROM DAYTON

A. F. Broomhall, of Detroit, made a plea for greater regard to little things that cause friction between farmers and traction lines. He advised a courteous attitude toward the general public and liberal compromises on debated points.

The success of the very enjoyable banquet and gathering was due largely to the efforts of the local committee at Dayton, headed by A. W. Anderson, of the Dayton & Xenia Traction Company, who had charge of all arrangements.

Some remarkably long trolley trips were made by members who attended this meeting. President Mathew Slush, of the Detroit, Monroe & Toledo Short Line, brought a large party of Michigan delegates from Detroit to Dayton in a special car, which made the run of 232 miles in very fast time. The following day this party continued on to Indianapolis, then up to Logansport, and returning by way of Fort Wayne, Lima, Findlay and Toledo, a total of about 720 miles. This is the longest continuous trip ever made by a single electric car, and the first time that a Michigan car has been seen in Central Ohio or Indiana. Delegates from Northern Indiana traveled to Dayton by way of Fort Wayne and Lima in the private car Lawton of

the Fort Wayne & Wabash Valley Traction Company, while members from Central Indiana traveled from Indianapolis to Dayton on the Dayton & Western "Interstate Limited."

CORRESPONDENCE

CURVE WEAR ON THE BOSTON ELEVATED

WILLIAM WHARTON, JR., & COMPANY, INCORPORATED

Philadelphia, Pa., Jan. 30, 1906.

EDITORS STREET RAILWAY JOURNAL:

In your issue of Jan. 27, in an article headed "Curve Wear on the Boston Elevated," you have a drawing showing forty-four days' wear of standard Bessemer steel rails upon a curve of the Boston Elevated Railway Company, the rails being then worn out. You also give drawings showing the wear of manganese steel rails, furnished by us, which, after the Bessemer rails were worn out, were placed upon the same curve, showing their gradual and remarkably small wear, in comparison with the Bessemer steel rails, for periods ranging from 365 days up to 1276 days (Oct. 23, 1905), being twenty-nine times the life of the Bessemer steel rails. You also state that the manganese steel rails were removed from this curve on the latter date, which is entirely contrary to the facts of the case, as the manganese steel rails are still in service and in excellent condition. If kept in the track until they shall be worn away as much as the Bessemer steel rails were worn away before they were taken out, the life of the manganese steel rails will then be more than sixty times as great as the life of the Bessemer steel rails.

As the above error in your issue of Jan. 27 is a very important one, I call your attention to it, knowing well that you will make such correction as may be needed.

WM. WHARTON, JR., President.

[Mr. Wharton's letter emphasizes the remarkable wearing qualities of manganese steel rails under conditions of great wear, and we are pleased to publish the correction to which he calls attention.—Eds.]

HISTORY OF THE CONDUIT SYSTEM IN WASHINGTON

Ithaca, N. Y., Jan. 24, 1906.

EDITORS STREET RAILWAY JOURNAL:

In the report on the San Francisco street railway situation by Wm. Barclay Parsons, published in your issue of Jan. 6, the statements are made that the adoption of underground conduit electric traction by the street railways of Washington, D. C., was the result of an accident, and that all these lines were formerly operated by cable. Inasmuch as the writer lived in the city during the entire period of development of mechanical traction, and, furthermore, made a somewhat detailed investigation of it a few years since, a correction of the statements made by Mr. Parsons does not seem out of place.

The street railways of the District of Columbia are operated by two companies: the Capital Traction Company, operating 40.69 miles of road, and the Washington Railway & Electric Company, operating 121.28 miles. This latter company is an operating company controlling a majority of the roads in the District.

The Metropolitan Railroad Company, now a part of the Washington Railway & Electric Company, was required by an act of Congress, in effect Aug. 2, 1894, to operate its lines by some form of underground electric construction, the time allowed for equipping the system being one year for the Ninth Street line and two years for the F Street line. As none of the so-called "systems" in use up to that time was at all satisfactory, the company's chief engineer, A. N. Connett, drew up his own plans and constructed on the Ninth Street line a conduit road, which has been highly successful and is at present in operation. With slight modifications, the same construction was adopted on the F Street line, and later installed on all lines of the Washington Railway & Electric Company within the city limits.

In the early nineties the Capital Traction Company, being also required to adopt some form of mechanical traction, installed a very complete and up-to-date cable system, which was operated with some success up to the fall of 1897, although the lines were too long and had too many curves to make the system entirely satisfactory. At the latter date a severe fire totally destroyed the company's large power house, which operated the main part of the system. Within twenty-four hours after the fire, the directors met and decided to install an underground electric system in the cable conduits. The system was installed and began operation in 1898, and it was so successful that the company also changed its Seventh Street line, about 5 miles in length, which was still operating by cable, to the electric system.

The total mileage of these roads operated by conduit was given by the United States Census report of 1903 as 85.08 miles, of which 29.69 was operated by the Capital Traction Company. Of the remaining mileage, 22.67 was changed by the Washington Railway & Electric Company from horse to electric operation before the Capital Traction Company had given electric power serious consideration. Only one of the lines of the Washington Railway & Electric Company, that on New York Avenue, 5.54 miles long, was ever operated by cable.

A. MORRIS BUCK, JR.

THE STARTING OF ROTARY CONVERTERS

Brooklyn, N. Y., Jan. 31, 1906.

EDITORS STREET RAILWAY JOURNAL:

It was not the intention of the writer, at the Dec. 15 meeting of the A. I. E. E. (see STREET RAILWAY JOURNAL, Dec. 23, 1905), to have others infer that converters could not be started from the a. c. side when equipped with pole dampers, for such is not the case. Converters have been started in this manner, but the starting current was excessive. The writer has one instance in mind in which a converter equipped with the most approved form of pole dampers was so started with a starting current of about three times full load, or twelve times that required when starting from the d. c. side with a regular starting set. The starting current which a converter draws is largely dependent upon the self-induction of the armature circuit. If the converter is equipped with pole dampers of approved and effective form, it is found that these dampers act as the closed secondary of a transformer, neutralizing the self-induction of the armature. The writer sees no reason why a converter could not be started from the a. c. side by means of an approved form of starting reactance, so that the converter could be equipped with pole dampers. It is true that many converters installed without pole dampers have operated so far satisfactorily, but now and again it becomes necessary to equip one of these converters with some form of damping device, due to hunting troubles.

As regards the best method of starting converters, it may be interesting to note the results of an investigation on this point conducted by a large corporation in New York which decided to equip its lines with electricity. The result of this investigation was the decision to dispense with all forms of starting sets and induction motors, and so to arrange the windings of a converter that it could be started either by low-potential taps connected to the a. c. side or from the d. c. bus-bar. The advantages of this decision are at once apparent. Under ordinary service conditions, the converters will be started from the d. c.

side, but in emergency cases where time is a very important factor, the converters will be started from the a. c. side.

In starting converters from the d. c. bus, it is found that sudden changes in the bus pressure result in wide fluctuations in the current input of the converter when all of the starting resistance has been cut out. The reason for this is obviously a low armature resistance and the inability of the armature, owing to its inertia, to change its counter e. m. f. with sufficient rapidity. To avoid these fluctuations, Charles F. Scott has suggested that the last point on the starting rheostat be left in while synchronizing. The steadying action of this resistance is similar to that of an arc lamp resistance. This method has been employed with great success by H. G. Stott, of the Interborough Rapid Transit Company, in some of the Interborough sub-stations.

Sidney W. Ashe.

NEW ENGLAND STREET RAILWAY CLUB

The January meeting of the New England Street Railway Club was held at the American House, Boston, on the evening of Jan. 25. President Potter was in the chair, and the speaker of the occasion was Albert B. Herrick, of New York. His topic was "Pointers on the Economical Maintenance of Street Railway Property."

Mr. Herrick emphasized the enormous amount of money expended annually in the United States for the maintenance of street railways, and stated that at the lowest estimate the abnormal maintenance of the companies east of the Mississippi, and between Kentucky and Canada, is $17,500,000 per annum. At first sight it would seem that certain classes of service would be characterized by very high maintenance costs. One would expect a service having heavy grades and many stops per mile would be inseparable from excessive wear and tear upon the equipment, but Mr. Herrick's analyses of the physical conditions present upon many roads in the country show that the character of service has nothing whatever to do with the matter. The lowest maintenance cost per car-mile is found on the roads having the heaviest service. California has the best record, largely because the lines in that State are so far removed from the supply markets. When supplies are easy to get, the maintenance cost is likely to be high, but when it is hard to secure supplies, there is a much greater stimulus to make repairs over and over.

Maintenance is always lower when there is harmony between the operating and maintenance departments. In cases where the officials are encouraged to visit other roads and observe labor-saving devices and up-to-date methods elsewhere, the best results have been secured. The highest maintenance arises in the cases of roads which are not in touch with other progressive lines. The better plan in maintenance work is not to wait until something happens, but to anticipate to-day what is likely to happen to-morrow. Mr. Herrick exhibited a considerable number of diagrams showing the relative maintenance costs upon various roads, and pointed out the great differences in the figures. He stated that if the maintenance expense per car-mile presented on one road could be reproduced on another specific system, the annual saving would be at least $1,000,000.

The cost of power in a street railway plant should be considered as the expense of manufacturing a definite finished product from raw material. Ordinarily the items of labor, coal, oil and waste are all that are considered in calculating the cost of power production. In order to figure the true cost of power, fixed charges based upon the investment should be introduced, although very few roads follow this practice.

Mr. Herrick described briefly his autographic test car, and pointed out its sphere of usefulness in determining the physical conditions of feeder systems, bonds, the track, joints and rolling stock. This car has now covered about 8000 miles of track and recorded the condition of some 2,700,000 bonds. About 1 ton of paper has been used in the apparatus. The drop across the terminals of a rail-bond can be recorded by the milli-voltmeter of the Herrick car when the car is making a speed of about 10 m.p.h. The records of the apparatus are obtained by allowing high-tension discharges to pass along the milli-voltmeter needle through the moving paper, the puncture marks giving the indication desired. Line losses can be studied with great convenience, and it is very important to know where and how the losses occur, so that the feeder layout can be changed if necessary. Losses in distribution reflect on the power cost and also upon the heating of the equipment. When peak loads occur at different times, it is generally a good plan to tie feeders together so that they will reinforce each other, but there is not much to be gained by this practice when the duties of each feeder are practically the same in regard to the time of heavy service. The study of underground conditions is important, particularly as bonds and other wires are often heedlessly broken by workmen. Mr. Herrick then showed how the power consumption is in some respects an index of the general depreciation of the system, citing the case of a road which increased its power consumption in kw-hours per car-mile from 1.8 to 3.5 from 1901 to 1904. By connecting the test car or equivalent apparatus to about 1000 ft. of street railway line and track, the performance of different cars can be determined without the knowledge of the motormen.

At the conclusion of Mr. Herrick's address a discussion was started, and several interesting points were brought out. The resistance of the earth varies greatly with temperature near the salt water. Mr. Herrick said that for general approximations one could consider that 1 sq. yd. of earth against a rail has a resistance of 40 ohms, whereas the same area of concrete has a resistance of 120 ohms. A remarkable point which Mr. Herrick's tests show is that the older equipments have the lowest cost of maintenance. In Ohio, apparatus built in 1893 and 1894 shows the lowest maintenance, and in Albany, N. Y., the "12a" motors in use in that city have a remarkable record in the way of moderate repair charges. Mr. Herrick said that his tests indicate that the safe temperature rise in a railway motor for all-day service should not exceed 22 degs. C. above the surrounding air; a rise of 32 degs. is of very doubtful safety, and a rise of 42 degs. prohibitive and highly dangerous.

J. W. Corning, of the Boston Elevated Railway Company, mentioned the increase of load which occurs upon that system as the temperature decreases. It is almost exactly .7 of 1 per cent per degree fall between 70 degs. F. and 10 degs. F. The explanation is difficult to give, for the resistance of the metallic circuits decreases with the decrease of temperature. Possibly the resistance of the earth increases as the temperature falls, so that the total resistance of the return circuit is enough greater to considerably offset the conductor resistance decrease. Mr. Corning offered no explanation, but John Lindall suggested that possibly the influence of the temperature upon the bearings of the rolling stock might be a factor.

Mr. Herrick spoke highly of electrically-welded joints, as he had investigated their conductivity, notably in Rochester, Cleveland and Brooklyn. The quality of the cast-welded joint depends largely upon the temperature at which it is made. In good practice a 180-lb. weld on a 90-lb. rail will have a resistance equivalent to about 18 ins. of service rail. Mechanical bonds are no better than the man who puts them in. They should never be installed in damp weather. With a good hole and compressor driving they should last five years. Soldered bonds have a tendency to come off in cold weather, though there is no doubt a future for this type. At present they seem to lack the mechanical stability desired. Two fertile causes of increased power consumption are the rubbing of brake-shoes set too tightly against the wheels and the turning on of power before the brakes are released. The meeting adjourned at 10 p. m., with a vote of thanks to the speaker.

IMPACT MACHINE FOR TESTING BRAKE-SHOES

Some years ago the Lappin Brake-Shoe Company, of Bloomfield, N. J., built an impact machine for testing the uniformity of brake-shoe body metal. Owing to the effectiveness and simple construction of this machine, similar ones were installed later in the works of all the other branches of the American Brake-Shoe & Foundry Company.

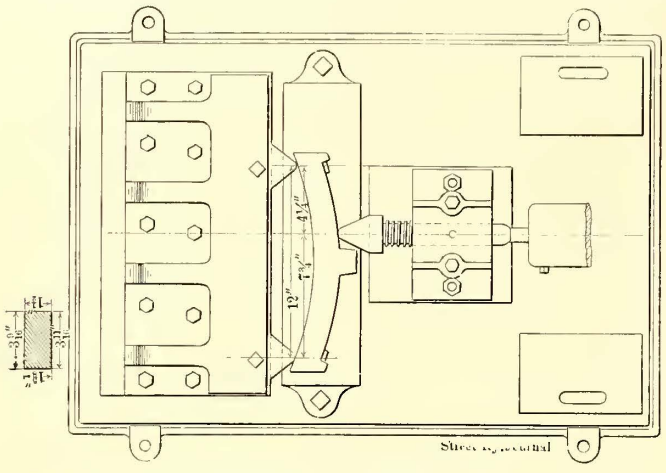


FIG. 1.—PLAN OF MACHINE FOR TESTING BRAKE-SHOES, AND SECTION OF SHOE

As shown in Fig. 2, the impact is obtained by swinging a hammer against a plunger, which in turn strikes the brake-shoe on one side of its lug, as illustrated in Fig. 1. The hammer weighs 55 lbs., and swings out from the shoe on a radius of 5 ft. The test shoes are all of the M. C. B. Christie type, without steel backs or other reinforcement. Part of Fig. 1 shows a section taken 1½ ins. either side of the center of the shoe. The length and other dimensions are according to the M. C. B. standard.

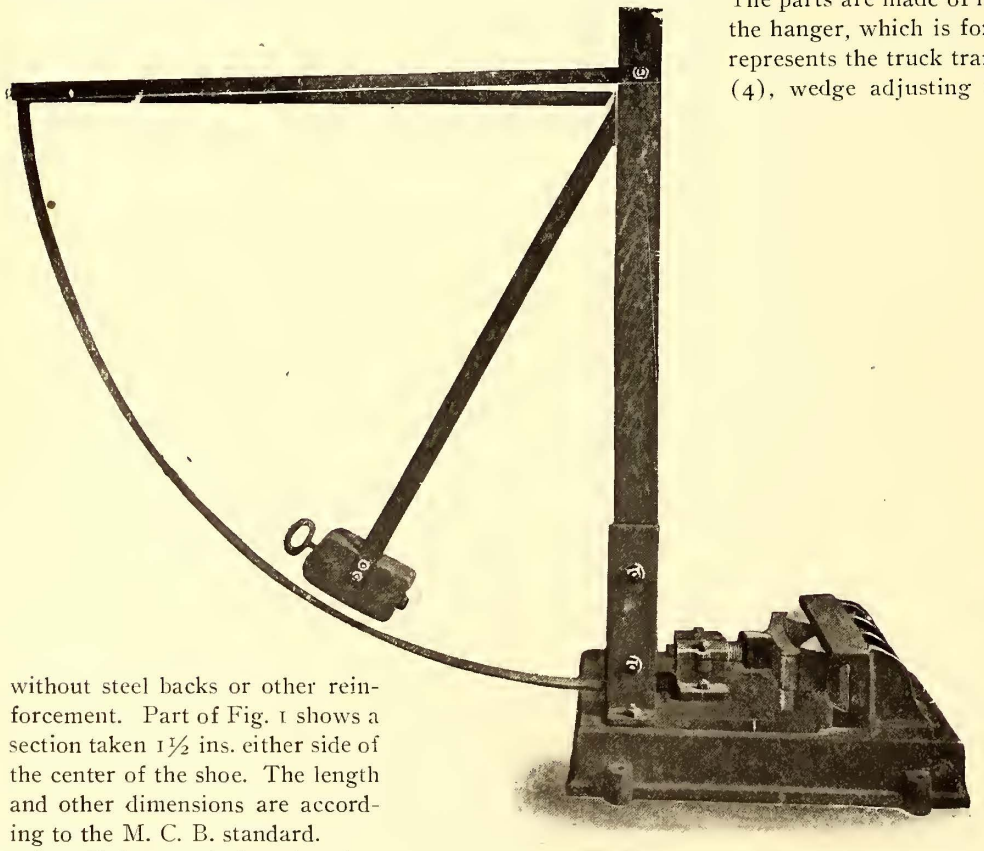


FIG. 2.—VIEW OF THE IMPACT BRAKE-SHOE MACHINE JUST AS THE HAMMER HAS BEGUN ITS SWING

It will be noted that the shoe is placed against the anvil with the knife edges 12 ins. centers. For the first blow the hammer is swung through an arc of 40 degs., the distance being increased 2 degs. at a time until the shoe fails. It is necessary to keep all bolts, set screws and other adjustable parts carefully regulated. The shoe must lie dead on the knife edges, allowing no lost motion between the knife edges and the point of contact of the hammer and plunger. Sample shoes are cast and tested every day on these machines in order that the company may keep its product uniform. It is seldom that any of the material fails to meet specifications—that is, at the 54-deg. point of arc—in fact, the shoes frequently run up to 60 degs. and 70 degs.

A NEW NOISELESS BRAKE HANGER

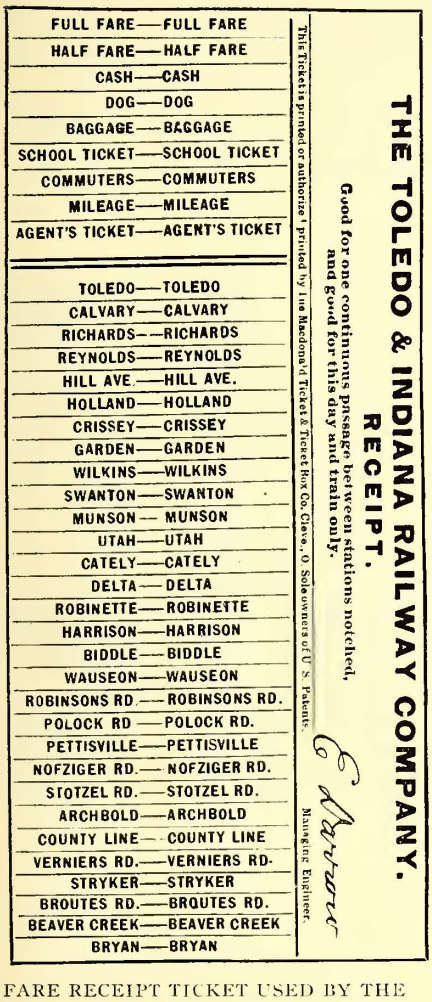
The J. G. Brill Company has recently perfected a new type of brake hanger, which automatically tightens as the bearing parts are worn down, and thus rids the truck of the objectionable noise commonly made by loose hangers. The Brill noiseless brake hanger, as it is called, has been used by a number of railroads for the last six or seven months and has fully demonstrated its efficiency under all conditions, and is now being placed on a large number of trucks. It was invented by G. Martin Brill, president of the company, who has made an exhaustive study of the subject, and believes that this device meets the requirements in every particular.

It will be seen by reference to the illustration that there is no thread to work loose and defeat the purpose of the device, but instead a ball and socket joint with a cap socket, which is always pressed firmly against the ball by a wedge-shaped casting. A pair of coil springs advances the wedge and takes up the slack occasioned by wear. The springs are sufficiently large to insure the proper amount of pressure at all times. The wedge has a movement of 1½ ins., and according to the experience of the various roads up to date, the socket castings will last about two years. The wear, of course, is reduced by the fact that the parts are held closely together at all times. The parts are made of malleable castings, with the exception of the hanger, which is forged. In the illustration presented, (1) represents the truck transom; (2), hanger holder; (3), wedge; (4), wedge adjusting spring, of which there are two; (5), upper socket; (6), lower socket, divided; (7), hanger; (8), brake beams. This hanger is made for all sizes and styles of trucks, and is arranged to connect directly with a special form of brake-shoe holder for trucks which have inside-hung brakes and where space must be economized.

NOISELESS BRAKE HANGER WITH AUTOMATIC TIGHTENER FOR TAKING UP BEARING WEAR

FARE RECEIPTS ON THREE WESTERN INTERURBANS

The Toledo & Indiana Railway Company has adopted the MacDonald "closed system" of cash-fare receipts, and E. Darrow, manager of that company, has made an interesting change in the standard type of receipt usually put out by the MacDonald Ticket & Ticket Box Company, of Cleveland. The device has been described in these columns several times, and it will be remembered that it consists of a closed box with a pad of tickets attached and notchers moving up and down on the frame of the box which cut notches in the receipt. The usual receipt has been for cash fares only, and the receipt contains the names of the towns and the amount paid. Mr. Darrow has dispensed with the plan of showing the amount paid, as this in reality is superfluous, because the distance traveled gives sufficient indication to the auditor as to the amount paid. In place of this, the Toledo & Indiana ticket contains several classifications of fares, as indicated in the illustration herewith. One of these receipts is therefore issued to every passenger, no matter what form of transportation is tendered to the conductor. The plan gives an excellent check, as the number of stubs turned in must correspond with the number of passengers carried, and it is possible to tell between what points each passenger travels.



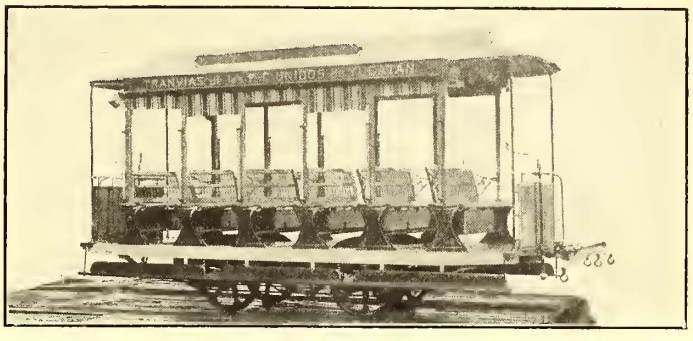
FARE RECEIPT TICKET USED BY THE TOLEDO & INDIANA RAILWAY CO.

The Jackson & Battle Creek Traction Company is using the MacDonald cash-fare receipt in connection with the Ohmer register, and the two systems give a double check on the conductors. Several roads are using the MacDonald device for issuing return-trip tickets; in this case the receipt contains a duplicate coupon, which is good for the return passage. This device is now in use on over thirty prominent interurban roads, and it is proving to be a very simple, reliable and economical method of accounting for cash payments.

The Michigan Traction Company has abolished the zone system of registering fares. Hereafter conductors on the interurban cars will ring only 5-cent cash fares on the register. Tickets will not be registered, neither will cash fares over 5 cents, a duplex ticket being given to the passenger in case his fare is over the minimum amount. The rule recently put into effect allowing stopovers has been abolished, and those desiring stopover tickets will be notified of the rule. Those riding on annual passes, which in a measure correspond to the mileage books of the steam roads, will be asked to sign a sort of receipt for transportation each time their passes are used. These receipts will be signed on the cars and given to the conductors.

AMERICAN CARS FOR YUCATAN

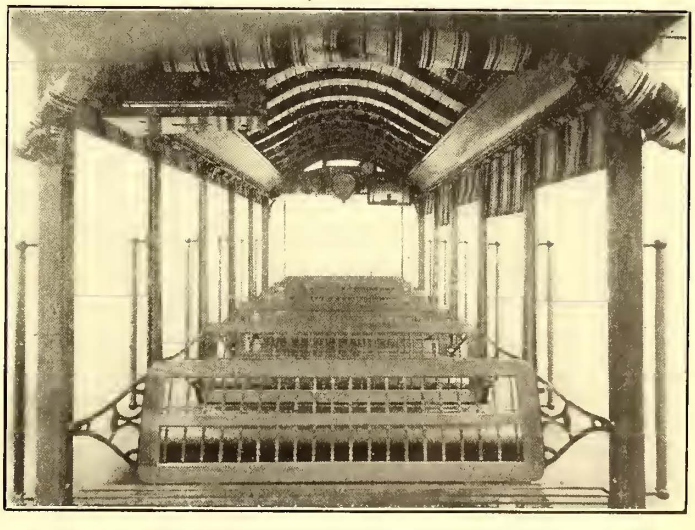
The Tranvias de los F. C. Unidos de Yucatan is one of the few street railways in the peninsula, and is at Merida. The State of Yucatan occupies a large portion of the peninsula of that name, and is more than half the size of Kansas. Its capital is Merida, which is about 50 miles from the northern sea coast, and is connected with the seaport cities of Progreso and Campeachy by steam lines, and also with cities in the interior. The



SIX-BENCH OPEN CAR FOR YUCATAN

streets have recently been paved with brick and asphalt and a system of sewerage installed. The railway company has replaced its rails with 8-in. girders and expects to operate with electricity before long. At present mules are employed for hauling its 200 cars.

The J. G. Brill Company has supplied a large part of its equipment and has recently shipped a lot of six-bench open cars like that shown in the illustrations. Half the equipment consists of closed cars, which are used during the rainy season, which lasts about five months. Formerly operation was rendered difficult on account of the large amount of standing water, as there was no sewerage system to carry it away, but now the city is being modernized, and with the newly paved streets, an impetus has been added which will aid considerably in its development. The company is capitalized at $400,000



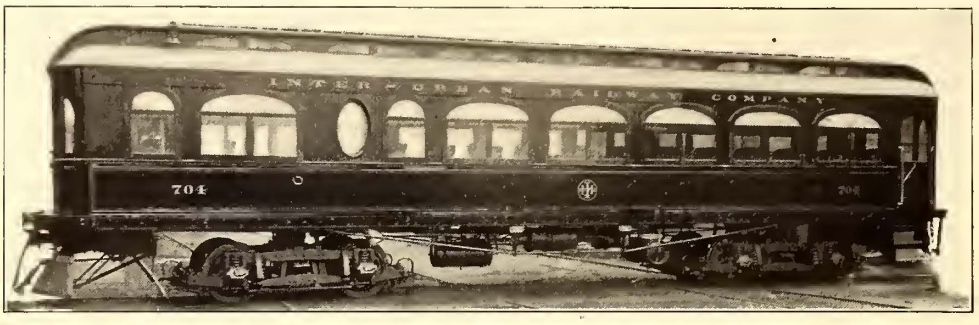
AN INTERIOR VIEW OF THE YUCATAN CAR

(Mexican money). It is distinctly a local concern and its capital is held very closely.

The new cars are 17 ft. 11 ins. over the crown pieces, and 5 ft. 1½ ins. wide over the sills; width over the posts at the belt, 6 ft. The illustrations show the general details. It will be noticed that the roof is of carline finish, and is provided with narrow headlinings at the sides, with advertising card moldings at the top and bottom. A clock is placed over the fare register at one end of the car. Brill brake handles, round-corner seat-end panels and other of the builder's specialties are included in the equipment.

CARS FOR THE NEW DIVISION OF THE INTERURBAN RAILWAY COMPANY OF IOWA

The eight cars shown in the illustration recently left the works of the American Car Company, at St. Louis, for Des Moines on their own wheels. These cars are for use on the division just completed of the Interurban Railway Company's system which has Des Moines as its operating center. The new line is known as the Beaver Valley division, and extends to Perry, about 35 miles northwest of Des Moines, and passes through the towns of Herrold, Granger, Moran, Woodward and Gardner. The Street Railway Journal described the Interurban Railway Company's system in the leading article of the issue of June 20, 1903, under the heading "A Remarkable Iowa Interurban." The remarkable feature to which attention was called was the fact that a large amount of traffic was secured in a territory which at first inspection would seem to be so sparsely populated as to make possible no adequate returns on an investment in an interurban line. The reason given was that, although the population was comparatively small, the exceedingly fertile soil made the district very prosperous. It is stated that the soil of Iowa yields more per acre than any other land in the United States, with the exception of the fruit valleys of California.



ONE OF THE NEW SINGLE-END INTERURBAN CARS RECENTLY FURNISHED TO THE INTERURBAN RAILWAY COMPANY OF IOWA FOR OPERATION ON ITS BEAVER VALLEY DIVISION

The system has been in operation for the past four years and now comprises 35 miles of track, the chief division running to Colfax, about 23 miles to the east of Des Moines. The company was organized under the general railroad laws of the State, and does a considerable amount of freight business, which it handles in standard cars in less than carload lots, interchanging traffic with several of the steam railroads. The freight business on the Colfax division averages from twenty-five to thirty standard carloads per day. There are about ten stock yards along the Colfax and the new Beaver Valley divisions, and the facilities for handling grain are excellent. A large amount of coal is also handled from eight mines of considerable extent which are located on these two divisions. The company is closely allied with the Des Moines City Railway Company. Surveys have been made for extensions to the principal points north and south of the city, and altogether it is expected that 250 miles of lines will be included eventually in the system. Des Moines has a population of about 65,000, and is the capital of the State and its chief railroad center.

The new cars are for operation on the Beaver Valley division, and as there are loops at the terminals, are therefore arranged for operation in one direction. Four of the new cars are combination passenger and smoker, and four are combination passenger and baggage. The general dimensions are: Length over the bumpers, 50 ft.; over the platform, 48 ft. 4 ins.; over the body, 44 ft. 4 ins.; width over all, 8 ft. 10 ins.; length of the passenger compartment, 33 ft. 2 ins., and of the baggage compartment, 11 ft. 2 ins. The bottom framing includes 4¾-in. x 8-in. side sills, with 8-in. channels; the center and intermediate sills are 4¾ ins. x 6 ins., with 6-in. I-beams, and the end sills are 5¼ ins. x 6 ins.; thickness of corner posts, 3¾ ins., and side posts, 2¼ ins. The alternate posts are double. The motorman's compartment is placed in one front corner of the baggage room, and has a maximum length of 5 ft. 6 ins. and width of 2 ft. 10⅛ ins. All of the windows are furnished with storm sashes.

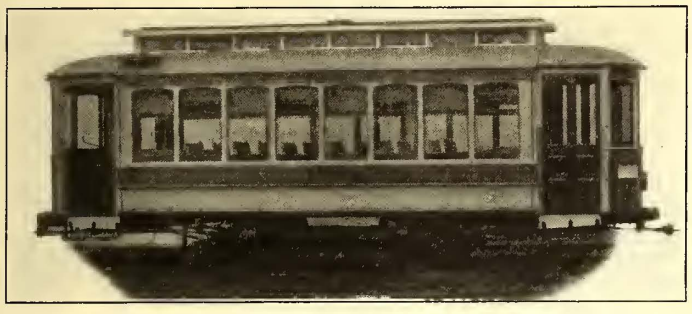
The interiors of the cars are finished in golden oak, neatly carved and inlaid, and the ceilings are of the semi-Empire style, tinted light green and decorated in gold. The high back leather upholstered seats, which are shown in the accompanying view of the interior, are of the Brill manufacture. Other Brill specialties with which the cars are equipped include platform gongs, signal bells and angle-iron bumpers. The cars are mounted on the Brill No. 27-E-2 type of high-speed truck. The trucks have 6-ft. wheel base, 35-in. steel-tired wheels and 6-in. axles. Four motors of 75-hp each are used per car.

INTERIOR OF ONE OF THE INTERURBAN RAILWAY COMPANY'S NEW CARS

EIGHT CARS FOR THE INTERURBAN RAILWAY COMPANY OF IOWA LEAVING THE CAR SHOPS AT ST. LOUIS ON THEIR OWN WHEELS

THE TOLEDO RAILWAYS & LIGHT COMPANY'S NEW CARS

Within the last few weeks the Toledo Railways & Light Company has put in operation ten new cars of the Brill grooveless-post, semi-convertible type, built by the G. C. Kuhlman Car Company, of Cleveland. This makes a total of 274 cars now operated by the company. This company operates all of the electric lines in the city of Toledo and controls practically all the electric lighting and power business and the underground conduits. The railway system includes 107 miles of track, which embraces sixteen different routes. Last year storage batteries were installed for the lighting plant and also for rail-



VESTIBULED SINGLE-TRUCK CAR FOR TOLEDO

way use, the former consisting of 296 cells of fifty-one plates each, and the latter of 264 cells of forty-one plates each. An extension to the power house has been commenced which will have an additional 125-ft. stack. When completed it will contain two 3000-kw steam turbines, direct connected to alternating generators; two 1000-kw rotary converters; one 1000-kw motor-generator set, and four 700-hp boilers. Two substations are soon to be built, in each of which will be installed two 500-kw rotary converters and accessories. When these additions are made, the capacity of the station will be 15,000 kw.

The railway company has used cars built by the Kuhlman Company for a number of years, and has also a considerable number of double-truck cars of the Brill semi-convertible type. The new cars are 20 ft. 8 ins. long over the bodies and 30 ft. 1 in. over the vestibule sheathing; width over sills, 7 ft. 8½

INTERIOR OF THE TOLEDO SEMI-CONVERTIBLE CAR

ins., and over posts at belt, 8 ft. The distance from the center to the center of the side posts is 2 ft. 5 ins.; height from the floor to the ceiling, 8 ft. 4½ ins.; height from the track to the under side of the sills, 2 ft. 2⅝ ins.; height from the under side of the sills over the trolley board, 8 ft. 11½ ins.; height from the track to the platform step, 14¾ ins.; from the step to the platform, 12 ins., and from the platform to the car floor, 7⅜ ins. The side sills are 3⅝ ins. x 5 ins.; end sills, 3½ ins. x 8⅜ ins.; sill plates, 15 ins. x ⅜ in.; thickness of corner posts, 3⅝ ins., and side posts, 2¾ ins. The interiors are finished in cherry, with birch veneer ceilings, neatly decorated. The seats, which are of Brill manufacture, are 35 ins. long, and because the pockets for the window sashes are in the roof instead of in the side walls, the seat ends are placed between the posts and against the side lining, leaving the aisle 22 ins. wide. The cars are mounted on single trucks of the Brill No. 21-E type, which have a wheel base of 7 ft. 6 ins., and the wheels are 33 ins. in diameter. The weight of a car and truck, without motors, is 17,900 lbs.

TESTING LABORATORY IN BUFFALO

A physical and chemical laboratory has been established in Buffalo under the name of "Buffalo Testing Laboratory," and will be located at the plant of the Buffalo Foundry Company, although entirely independent of that concern. The laboratory will have facilities for the inspection and testing of steel rails, structural steel and all metals, as well as for the analysis and test of cements and other building material. Arrangements have also been made for carrying out any electrical tests which may be required by customers.

The organization has an excellent backing and personnel. The president is George A. Ricker, one of the prominent civil and electrical engineers of Buffalo and the builder of the Niagara Gorge Railroad. The vice-president is Nathaniel W. Shed, who has had an extended experience as metallurgist with the Nashua Iron & Steel Company, at Nashua, N. H., and the Carnegie Homestead Works. Mr. Shed was also for several years professor of metallurgy at the Pennsylvania State College, and is now chemist and metallurgist of the Buffalo Foundry Company. The manager of the inspection bureau is M. E. Biggan, who for the past few years has been personal representative at Buffalo of Dr. P. H. Dudley in inspecting rails of the Lackawanna Steel Plant for the New York Central Railroad. For a number of years he has also inspected all the rails rolled in Buffalo for the Lehigh Valley and the Delaware, Lackawanna & Western Railroads. Mr. Biggan was formerly superintendent of the rail finishing department of the Maryland Steel Company, and was afterward connected for ten years with R. W. Hunt & Company, of Pittsburg.

In spite of the recent industrial development of Buffalo and its prominent position as a center for the production of steel rails, it has not been provided up to this time with a commercial laboratory and inspection bureau of this kind, and the officers of the new company believe for this reason that an excellent business should result. The office of the Buffalo Testing Laboratory is at 702 Ellicott Square, Buffalo.

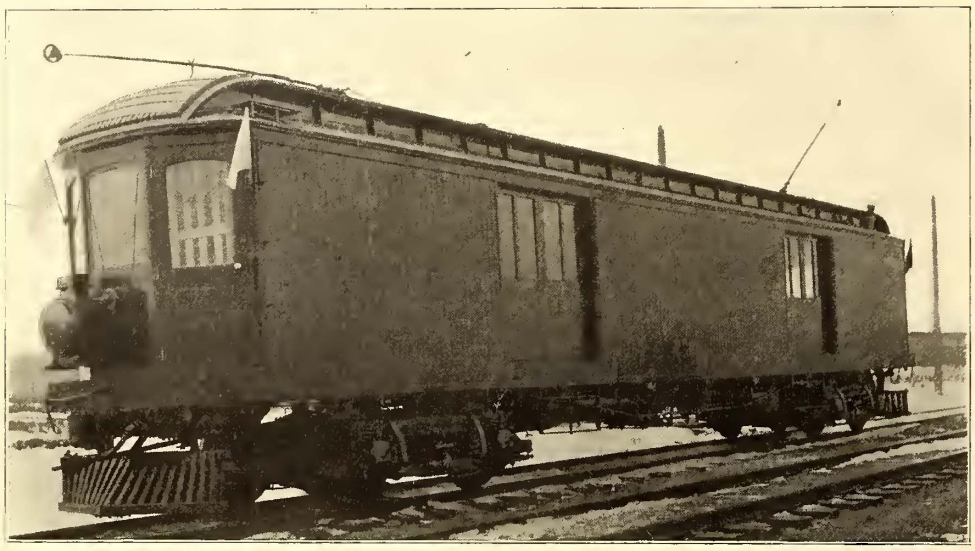
CONSOLIDATION OF SPOKANE RAILWAYS

Jay P. Graves and associates, of Spokane, Wash., have formed the Inland Empire Railway Company, with a capital of $20,000,000. It is understood that the prime purpose of the corporation is to consolidate the present electric railways of the Graves group. The new corporation, which will have an authorized issue of $10,000,000 in common stock and an equal amount in preferred stock, is organized by Jay P. Graves, president of the Spokane & Inland Company; F. A. Blackwell and Waldo G. Paine, of the Coeur d'Alene & Spokane Railway Company; F. Lewis Clark and Aaron Kuhn, of the Spokane Traction Company and of the Spokane & Inland Company; F. A. Blackwell and Waldo G. Paine, of the Spokane Terminal Company. Graves and Blackwell are financially connected with all of the various companies.

The Camden & Trenton Railway, which is controlled by the Trenton & New Brunswick Railroad, now has tickets on sale between Trenton and Camden, N. J., at the rate of 40 cents single or 75 cents excursion fare. The distance each way is about 36 miles. The company also has the largest and finest waiting room in the State at 12 South Warren Street, Trenton, where one of the largest storerooms has been converted into a waiting room and ticket office. Instead of the ordinary seats, there are plenty of chairs, including rockers. In order to lend to the attractiveness of the place, the front windows are decorated with potted plants and ferns.

HEAVY EXPRESS CAR USED BY THE UTICA & MOHAWK VALLEY RAILWAY COMPANY

Early in 1905 the Utica & Mohawk Valley Railway Company placed in service what is probably the largest and heaviest baggage and express car ever built for electric railway work. In designing the car to handle the regular baggage, freight and express service of the company, advantage was also taken to try out an unusually heavy type of electrical equipment, and it is understood the experience gained with this car is being used to good advantage in deciding upon the equipment to be adopted for passenger service on the electrified section of the West Shore Railroad from Utica west to Syracuse, upon which work is in progress.



AN EXTERIOR VIEW OF THE UTICA & MOHAWK EXPRESS CAR

The express car is 56 ft. over the crown pieces and 8 ft. wide over sheathing. The side sills are of long leaf yellow pine, 5¾ ins. x 7⅞ ins., with 8-in. x ¾-in. sill plates. The cross joists are 4½ ins. x 5½ ins. A slotted partition with door forms a motorman's compartment at each end. As will be noticed from the illustrations, there are two double sliding doors on each side of the car, and at the diagonally opposite corners there are smaller doors which swing outwardly, the platforms at these corners being cut away sharply along the door sill to the side of the car instead of making the usual curve. This arrangement of side and end doors greatly facilitates the loading and unloading of bulky freight and express matter, and also permits the carrying of long material as rails or poles. The carrying capacity is 20 tons.

The car can be used as a locomotive for hauling purposes, and is fitted with radial draw-bars for pulling electric cars, and also with heavy M. C. B. couplers for hauling steam railroad freight cars.

The electrical equipment comprises four Westinghouse No. 85 motors, rated at 75-hp each, giving an aggregate motor capacity of 300 hp. The car is equipped with Westinghouse electro-pneumatic multiple-unit control, and is fitted with both straight and automatic air brakes. The leads, motor wiring and all electrical circuits, with the exception of the low-voltage leads from the storage battery used in connection with the turret control, are in oak molding with four conduits, covered with a capping to correspond, and the turns are all square turns. The low-voltage circuits from the battery are placed in iron pipes.

The body of the car was built at the works of the J. G. Brill Company, and it is mounted on special Brill high-speed No. 27-E-3 trucks. The trucks each have a wheel base of 6 ft. 6 ins. The wheels are steel-tired and 36 ins. in diameter, and the axles are 6 ins. in diameter. The weight of body and trucks without motors is 51,060 lbs. The car has been in regular operation for about one year, and has frequently been run at speeds as high as 1 mile in 58 seconds.

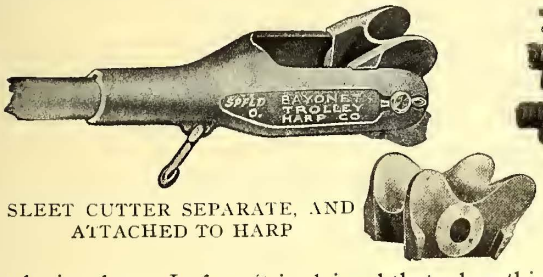
VIEW UNDER UTICA & MOHAWK EXPRESS CAR, SHOWING MULTIPLE-UNIT CONTROL AND STRAIGHT AND AUTOMATIC AIR-BRAKE APPARATUS

INTERIOR OF EXPRESS CAR, UTICA & MOHAWK VALLEY RAILWAY

The Springfield, Troy & Piqua Traction Company, of Springfield, Ohio, is building in its own shops five standard freight cars. Each car is 34 ft. long, has a capacity of 40,000 lbs. and will be hauled as a trailer by the company's regular express cars. The company is working up a very large freight business and is interlining with a number of the electric interurban railways in Western Ohio.

A NEW SLEET CUTTER

A new and very simply designed detachable sleet cutter has just been added to the saving devices made by the Bayonet Trolley Harp Company, of Springfield, Ohio. The brass cutter proper resembles very much the wings of a large butterfly, and is used in combination with the Bayonet detachable harp head, fitting in the head in place of the wheel and requiring no contact washers or springs. The cutter block is so designed and closely fit in the head that the contact and, consequently, the conductivity is greater than on any other device of its class. This cutter block, being reversible, affords double service, as when one cutting edge wears out, the other can be made to take its place. In fact, it is claimed that when this cutter wears out, nothing is left but the hole where the axle goes through.

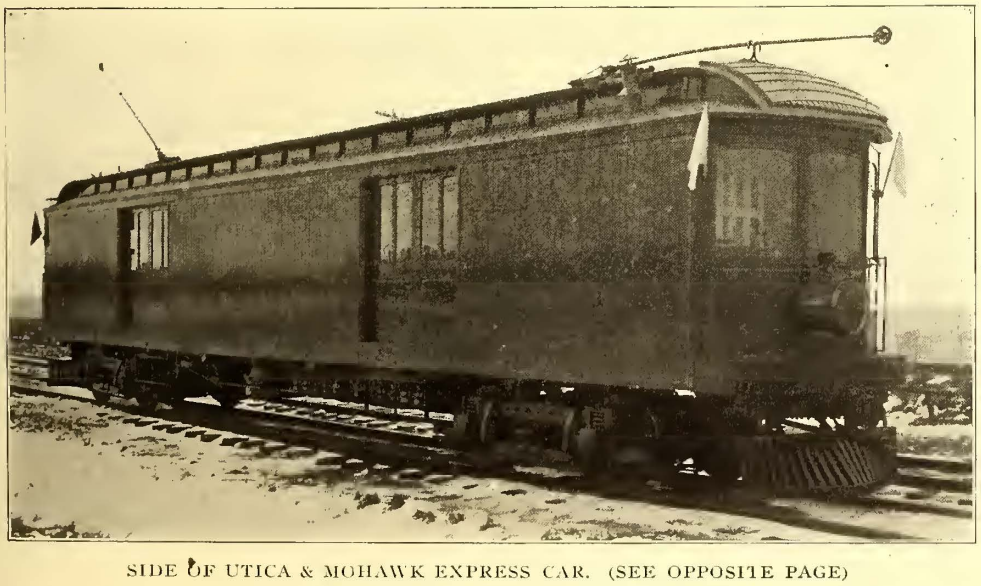


SLEET CUTTER SEPARATE, AND ATTACHED TO HARP

Another very important advantage claimed for this cutter is its very light weight. While most sleet cutters add from 1 lb. to 2 lbs., this cutter reduces the weight at the end of the pole from 2 lbs. to 3 lbs., thus increasing the tension on the wire at a time when it is most needed. This combination cutter and head can be attached to or detached from the harp without the use of any tools in the very short time of 10 seconds. There are no bolts, screws, clamps or other devices to get loose, and when the sleet season is ended, the head can be used with wheel.

COMBINATION INCANDESCENT AND ARC HEADLIGHT

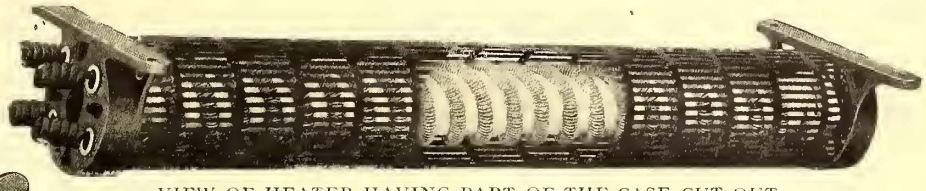
The Trolley Supply Company, of Canton, reports that since it secured control of the Climax combination arc and incandescent headlight from the Globe Electric Manufacturing Company, a few months ago, the headlight has been greatly improved. Special attention has been given to improving the clutch mechanism by which the carbons are fed and to eliminating the "dark spot" which exists in all arc lights. The combination feature is useful in towns where the arc light is not permitted. Here the incandescent circuit only is used. The conductor changes the light by simply changing switch or plug. It is claimed that this has been proven much preferable to the use of a screen or other methods for dimming the light. A good arc is obtained by 1½ amps., and the maximum consumption is 3½ amps. Carbons ⅜ in. in diameter are used, and the reflection of the shadow is almost imperceptible. The company will manufacture this headlight in connection with its other specialties, the Knutson trolley retriever and the American trolley catcher.



SIDE OF UTICA & MOHAWK EXPRESS CAR. (SEE OPPOSITE PAGE)

ELECTRIC HEATERS FOR NEW YORK CENTRAL RAILROAD

The New York Central Railroad has just closed a contract with the Consolidated Car Heating Company, of New York, for furnishing 180 electric heaters for steel cars for suburban service. There will be thirty-six heaters per car, thirty being of the cross-seat type for use under cross-seats, and six of the truss-plank type for saloons and motormen's cabs. One of the truss-plank heaters will be used in each saloon and two in each of the motormen's cabs.



VIEW OF HEATER HAVING PART OF THE CASE CUT OUT

TRUSS PLANK TYPE ELECTRIC HEATER

The accompanying cuts illustrate the heaters to be furnished on the above contract. The cross-seat heater is a new type of double-coil heater, having but one porcelain spindle with a double groove, on which are wound two coils, and all lead wires are brought out of the heater at one end. The upper illustration, with a section of the case cut out, shows the arrangement of the coils and spacing between same, which allows the freest possible circulation of air. There will be 4212 ft. of wire used in the heater coils in each car equipment, or 144 miles of wire in the 180 equipments. Each equipment will be arranged for four graduations of heat. This company reports the sale of 51,815 electric heaters for use in 4259 cars during the year 1905.

The American Engineering Company, of Indianapolis, Ind., is preparing a new map of the electric interurban railways of Indiana. The map will measure 2 ft. x 3 ft., and will show both the operating lines and those under actual construction.

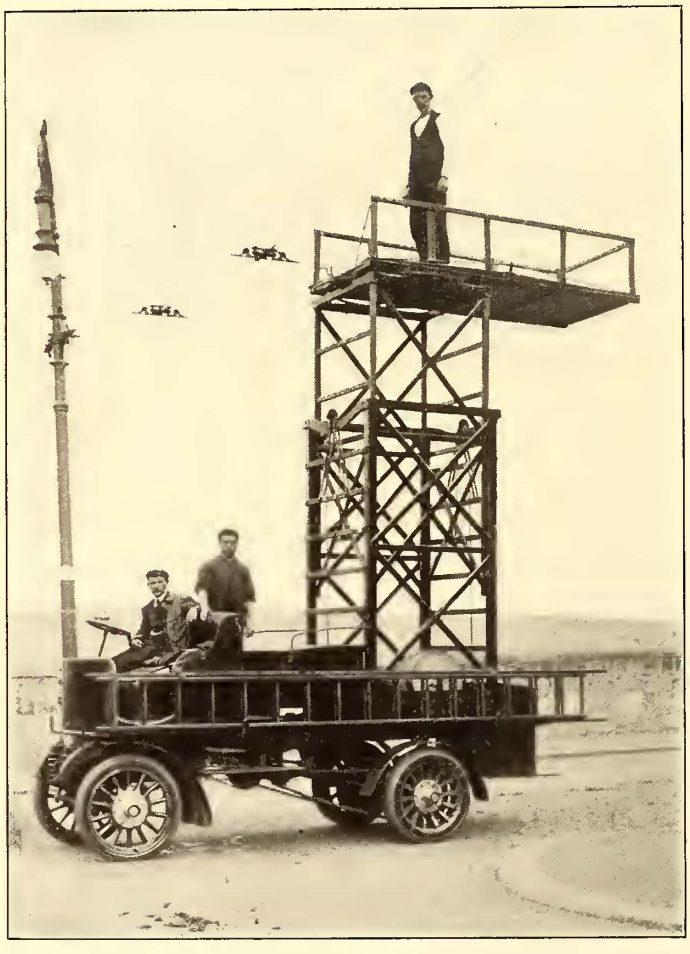
ELEVATED BRAKE-SHOE PRACTICE IN CHICAGO

The Northwestern Elevated Railroad, Chicago, is using on motor trucks an M. C. B. flange brake-shoe with a steel back and chilled ends. The original weight of the shoe is 54½ lbs., and they are stopped at 16 lbs. with a loss in weight of 38½ lbs. These shoes give a car mileage of from 8000 car-miles to 9000 car-miles.

On the trail trucks the company uses a plain brake-shoe—that is, one without a flange. These also have a steel back and chilled ends. When put on, they weigh 22 lbs., and are worn to 6 lbs. A mileage of from 12,000 car-miles to 15,000 car-miles is obtained.

TOWER WAGON FOR GLASGOW

An interesting example of the method adopted by a number of tramway systems in Great Britain to enable repairs to be made quickly without depending upon line cars or horses is shown in the accompanying illustration, which is a view of the gasoline tower wagon built for the Glasgow corporation tram-

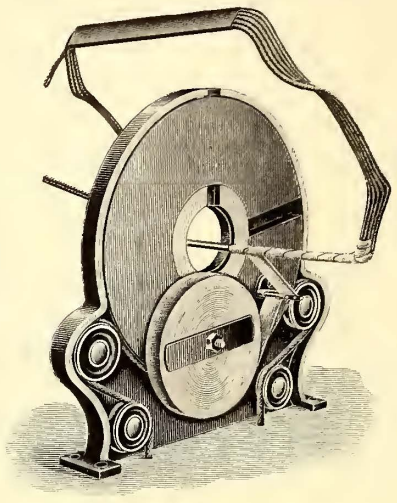


THE GLASGOW TOWER WAGON IN SERVICE

ways by the New Arrol-Johnston Car Company, Ltd., of Paisley, Eng. The type of body used for this car, of course, is evident from the illustration, and in this regard it only remains to say that it is constructed in the same substantial manner as this firm's standard motor cars. The tower wagon, however, is equipped with tool and material lockers, a drum for conductor and other wire, and many other fittings suitable for repair work. The gasoline motor used is of 12-hp capacity, and is of the two-cylinder horizontal-balanced type, running at 800 r. p. m. The gearing provides for two or four speeds forward and one reverse speed. Renold "silent" chains connect with the driving axles of the vehicle.

ARMATURE COIL TAPING MACHINE

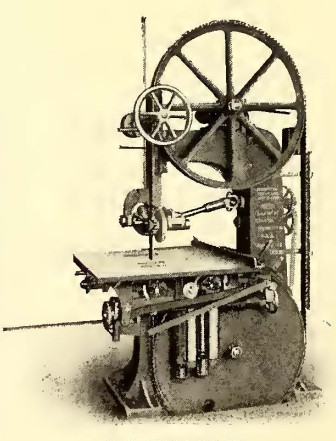
The armature coil taping machine shown in the accompanying illustrations is one of the numerous devices designed and built by the Frank Ridlon Company, of Boston, Mass., to save time and money in electric railway shops. When in use the machine is bolted to a bench and furnished complete with a treadle fastened to the floor. Bronze is used for the working parts of this taper. Any speed can be obtained, according to the pressure put upon the treadle. The tape is fed through rolls, giving any tension that may be desired. The machine is very compactly constructed, as is shown by the following principal dimensions: Height, 11½ ins.; width, 12½ ins.; thickness, 2½ ins. The weight is about 15 lbs.



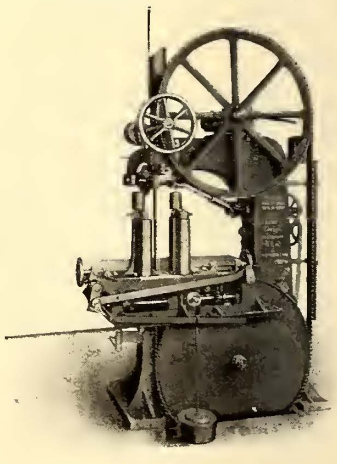
ARMATURE COIL TAPING MACHINE

A COMBINATION RESAW AND RIP-SAW

For crowded shops or where there is not enough ripping and resawing to keep separate machines busy, the J. A. Fay & Egan Company, of Cincinnati, Ohio, makes a combination rip and resaw to do both kinds of work as good as the separate machines. To those who are now using circular saws, this tool comes as a special boon, because with it the big waste in sawdust from circular saws is abolished and the user obtains the benefits of a band saw. While the combination of these two machines in one is entirely new, the mechanism is very simple



AS A RIP SAW



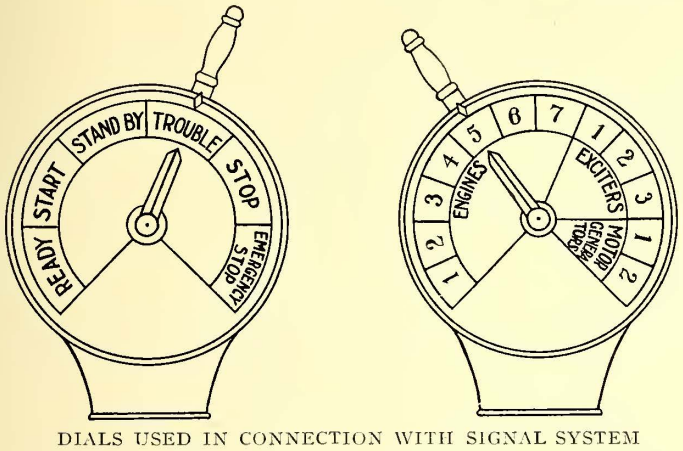
AS A RESAW

and the machine can be changed instantly from rip to resaw by one man.

The table is 35 ins. x 43 ins., and is mounted on a rocker bearing. The front part carrying the resaw rolls is instantly reversible, and the lower side when reversed forms a clear table for ripping. It rips 24 ins. between saw and fence, 18 ins. under guide, resaws 8 ins. thick. The saw guides are of the company's latest type, and are placed close to the cut of the saw. The feed of the machine is regulated by variable speed frictions, operated by a lever convenient to the operator. For resawing, the feed may be varied from 10 ft. to 50 ft. per minute, and for ripping from 30 ft. to 140 ft. per minute. A special brake mechanism stops the machine instantly.

SIGNALING SYSTEM USED IN PROVIDENCE

While mechanically-operated dial systems are very commonly employed on ships for communicating between the pilot and boiler rooms, it has not yet been fully recognized that they may be used to similar advantage in land stations. In many large power plants of to-day it has been found advisable to isolate the controlling apparatus from the engine room by placing the switchboard in a high gallery from which the switchboard attendant can act as a kind of station pilot. Of course, this plan introduces the necessity of some form of signaling system, as it would be dangerous to depend upon verbal orders, which could be easily misunderstood by the engineers below on account of the usual noises caused by working machinery. The recent adoption of the Cory ship telegraph system in one of the stations of the Philadelphia Rapid Transit



DIALS USED IN CONNECTION WITH SIGNAL SYSTEM

Company, therefore, may lend additional interest to a description of the same system which has been giving very satisfactory service since the opening of the Manchester Street (Providence) station of the Rhode Island Company two years ago.

In the Manchester Street plant the switchboard is placed in a gallery at a considerable height above the engine room. The signaling apparatus consists of two sets of dials mounted on stands, the latter containing two wheels operated by handles and chains. These chains run between both sets of stands. One pair of stands is placed in the switchboard gallery, and the other at a convenient place in the engine room. The markings of the dials for this station, as shown in the accompanying cuts, are arranged for seven engines, three exciters and two motor generators. The following account explains the operation of this system:

When the switchboard attendant observes that the increasing load on the line requires the throwing in of engine No. 4, for instance, he turns the outer handle on his left-hand stand until its pointer reaches the position "Start." The turning of the handle causes the ringing of an alarm gong and sets the inner pointer on the duplicate dial below to the same position. The switchboard attendant also turns the outer handle on the right-hand stand to the position No. 4 in the engine section, which indication is repeated by the inner pointer on the right-hand stand below. The engineer, upon looking at both of his dials, reads the order, "Start No. 4." To signify his obedience to this order, he turns the outer handles on his stands until their pointers are in line with the corresponding inner pointers. This action rings an alarm gong for the attention of the switchboard man, and also causes the inner pointers on the second set of stands to set themselves in line with the pointers on their outside handles, thus signifying to the switchboard attendant that his order is understood.

After the engine is up to speed, the engineer signals "Ready," which the switchboard attendant replies to by bringing his pointer to "Ready," and signals "Load" when ready to put the engine on the line. The orders for starting and stopping are given in this way, excepting in case of serious accident to the generating unit requiring it to be shut down at once, when the engineer will signal "Emergency Stop" and at once stop the engine. When the switchboard attendant receives this signal, it is his duty to take the unit off of the line without waiting to reply to the signal.

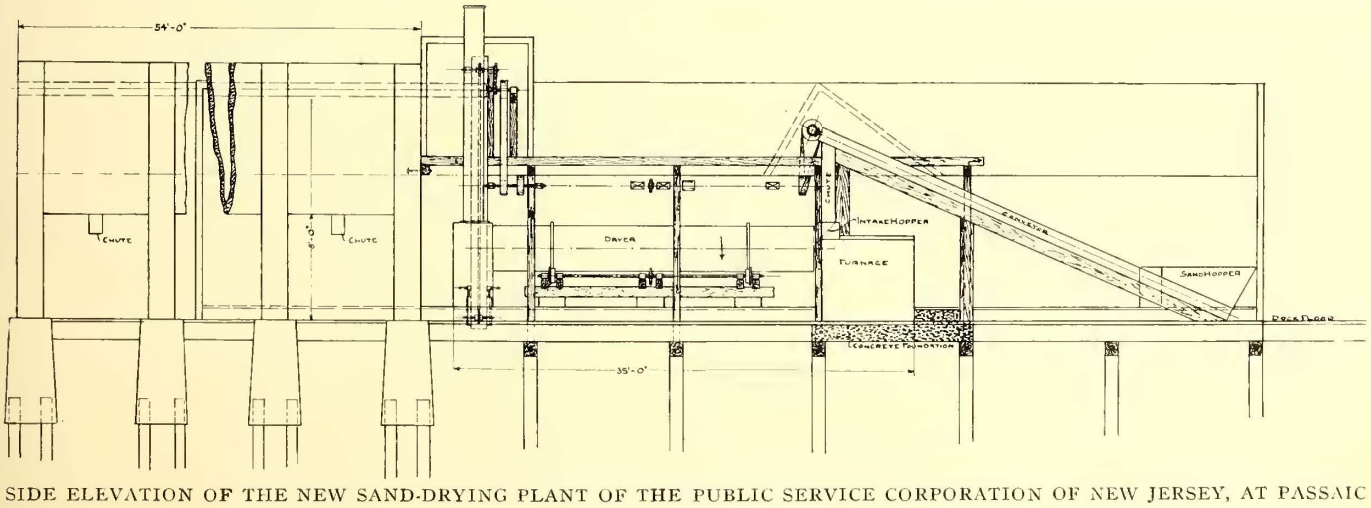
The instruments used are neatly finished in brass and composition metal, and are furnished with dials 15½ ins. in diameter. They were installed by Charles Cory & Son, of New York.

NEW SAND-DRYING PLANT FOR THE PUBLIC SERVICE CORPORATION OF NEW JERSEY

To be certain of having ready at all times large quantities of well-dried sand, required for its extensive street and interurban railway system, the Public Service Corporation of New Jersey has recently had installed an extensive sand-drying plant by the American Process Company, of New York.

This plant is at Passaic Wharf, near Newark, and only a short distance from the large shops and car houses on the Plank Road line. All sand will be delivered to this location by boat and hoisted directly to the hopper of the sand dryer. The construction of the drying apparatus is shown in detail in the accompanying drawing. It should be noted that a striking feature of the machine is its large capacity, namely, 10 tons per hour.

From the hopper which receives the sand, it is taken by an inclined conveyor and dropped through a chute to an intake hopper. From there it is delivered into the drying cylinder. The wet sand and the furnace gases enter the shell at the higher end. The wet material falls to the bottom of the dryer, is caught by a shelf, elevated to almost the highest point of the rotation, and is then showered through the furnace gases. This cycle of operations is repeated until the sand, in a dried condi-



SIDE ELEVATION OF THE NEW SAND-DRYING PLANT OF THE PUBLIC SERVICE CORPORATION OF NEW JERSEY, AT PASSAIC WHARF, NEWARK

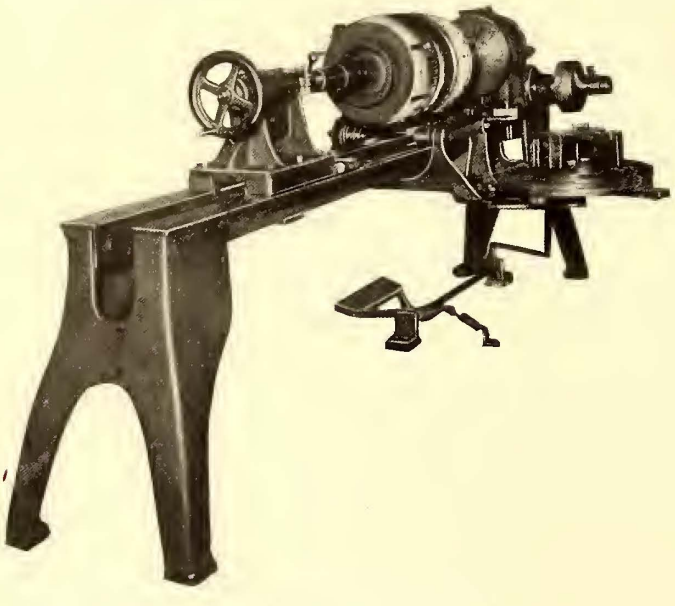
tion, is discharged from the lower end of the dryer, where it is caught by a conveyor and elevated to large sand bins, where it is stored until needed. The motive power for the whole arrangement is external to the machine, and can be either electric or steam. A track admits the cars of the electric railway company alongside of the bins where the sand is stored, and that portion needed at other places on the line can thus be conveniently transported.

This plant as designed by the American Process Company represents a considerable saving in labor as compared with methods used where the sand is handled by hand. One man only is required to operate, superintend and look after the firing of the furnace. It is expected that the saving in labor alone will pay for the plant in one year.

SELF-CONTAINED ARMATURE HEADING AND BANDING MACHINE

Among the many economical shop tools made by the American General Engineering Company, of New York, is the one for heading and banding armatures, which is shown in the accompanying illustration. This machine has been adopted as standard by the Public Service Corporation of New Jersey for its Plank Road shops, and is also used in the main shops of the Brooklyn Rapid Transit Company.

While every part of this device is designed to insure economy and reliability in operation and compactness in construction, special attention is directed to its self-contained tension and feeding attachment. This attachment makes it entirely unnecessary for the operator to straddle the wire, and the tension can be easily changed to suit the operator. As the wire is fed automatically from an arm, no handling is necessary, thus avoiding the inconvenience resulting from the use of other machines on which the wire in passing through fibre or other material becomes so heated by friction that it cannot be handled conveniently by the operator. It has been found that the installation of this attachment alone has cut the labor cost from $3.50 to $1.50 a day, besides giving neater and quicker work. At this rate the original investment on the machine is returned within a few months, and the later savings are, of course, clear profit.



SELF-CONTAINED ARMATURE HEADING AND BANDING MACHINE

The speed of this machine is 30 r. p. m. It will take any armatures up to and including 16 ins. in diameter. The principal dimensions are: Length over all, 9 ft. 8½ ins.; extreme width, 3 ft.; height, 4 ft. The weight is approximately 1500 lbs. In addition to this standard machine, the company also builds a heavier one with an increased swing for handling the large armatures used in motors for heavy interurban and elevated railway service.

A NEW AUTOMATIC TRACK SWITCH

Automatic track switches or point controllers are coming into general favor in England since they have been found both economical and reliable in service under the milder climatic conditions of that country. The type described in this article is known as Parr's automatic point controller, and it is a product of Hadfield's Steel Foundry Company, Ltd., of Shef-

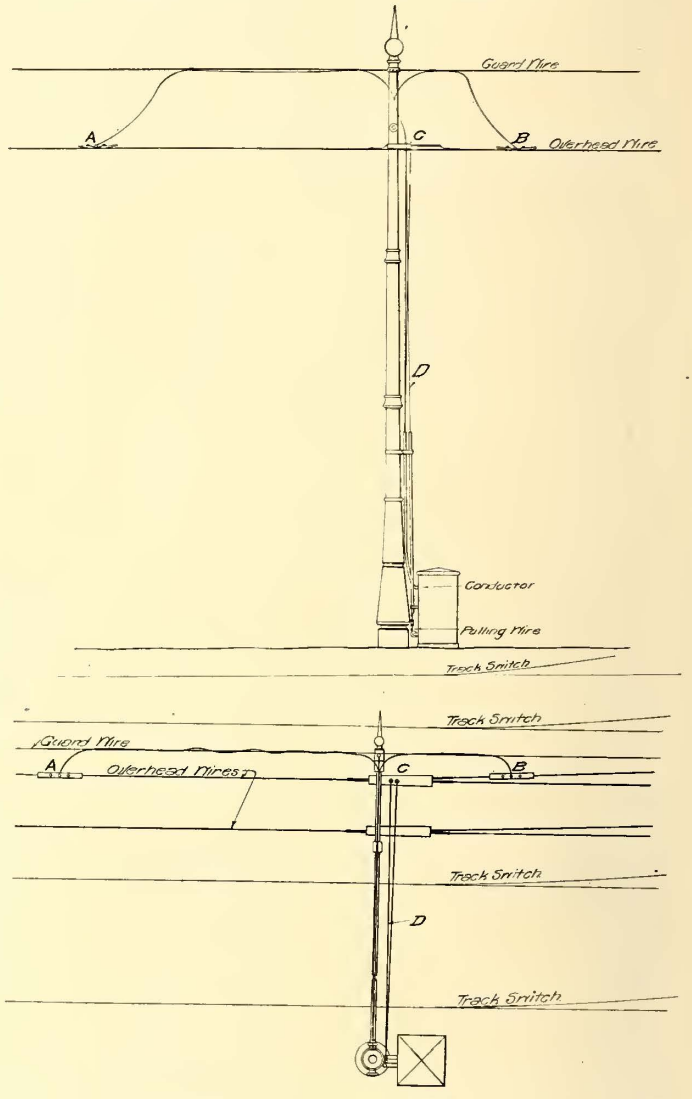


FIG. 1.—DIAGRAMS SHOWING ARRANGEMENT OF CONTACTS AND WIRES FOR AUTOMATIC TRACK SWITCH

field, Eng. A number of these automatic switches are already in successful operation on the Leeds, Bradford, Sheffield, Manchester, Halifax and other corporation tramways.

In the accompanying Fig. 1, the points marked *A* and *B* are contacts sweated on the overhead wires. It is not necessary to cut the overhead wires in any way. Where these wires meet they are joined to form one wire, which is carried down the pole to the contact terminal inside the switch box. The point C represents the overhead frog. A supply wire is carried from the ear pieces to the circuit breaker inside the controller box. It passes through the circuit breaker to the supply terminal on the terminal board, so that the electric current is always, as it were, suspended at the supply terminal waiting to be used. The point marked *D* indicates the hauling wire from the overhead frog, which is attached to the lever inside the switch box, to which the switch tongue is also coupled, and

by this means the tongue and frog are operated together. The electromagnet is wired to the same terminals as the contact and supply wires.

The method of operation is as follows: Cars wishing to operate the switch pass under the first contact *A*, with the controller on the first notch; they break contact with the overhead wire and complete the current circuit through the contact, but as soon as the trolley wheel leaves the contact, the current is again taken from the overhead wire. The momentary excitation of the electromagnet, caused by the trolley wheel at contact *A*, is sufficient to switch the current to the motor and set it in motion. The motor then continues to take its supply until the tongue of the switch has traveled over, upon which the machine automatically cuts off the current.

One terminal of the motor is also earthed, so that when its circuit is on, the current flows through the motor direct from the supply terminal to earth. Immediately the car makes contact at *B*, exactly the same action occurs as at *A*, but the motor rotates in the opposite direction and reverses the switch tongue. This reversing of the motor is brought about by a reversing switch, which reverses the current in the motor. When it is not necessary for the switch tongue to be operated, the motorman allows the car to coast through the contact *A*, with the motor controller "off" altogether.

At Leeds, where the first of these switch controllers was installed, it operates at a junction where cars pass at the minimum rate of 90 an hour for 19½ hours of the day and a maximum of about 100 cars per hour at busy times. Throughout this very severe test it has been operating with only one contact the track and overhead switch points, as well as the illuminated signals. On the very moderate basis that the switches are operated by every second car, this device made 140,400 operations up to July 1 last with no perceptible signs of wear on any of the parts.

Only one contact, attached to the electrical conductor, is really needed, thereby saving the automatic switch at the very least 50 per cent of the operations otherwise necessary if there are two contacts. The life of the device, which is many years, is thus greatly extended. Two contacts can, however, just as readily be used, if preferred, entailing no other alterations whatever. There is no chance of the insulation used in the above contact breaking down, owing to the particular arrangement employed.

There is no spark or bump, as the trolley wheel runs under the contact. The lamp current of the car cannot actuate the switching mechanism, while only the first notch of the ordinary car controller is more than sufficient to work it. This device can be "set" so that the driver cannot operate and "take" his points above a certain prearranged car speed. It is unaffected in its action by a variation of 150 volts in 550 volts, but can be made to work equally well at all pressures between 300 volts and 600 volts. Damp has no injurious effect on the controller; the street box containing one of these machines on the Leeds City Tramways (being undrained) has at intervals been full of water up to the road level for some weeks past.

Switchmen, of course, are entirely unnecessary, and the wages thus saved pay for this machine in less than one year, after which the cost of operating the point is nothing. It should be noted that this automatic switch is sufficiently powerful to operate the connected movable track and conductor points in conduit tramway systems.

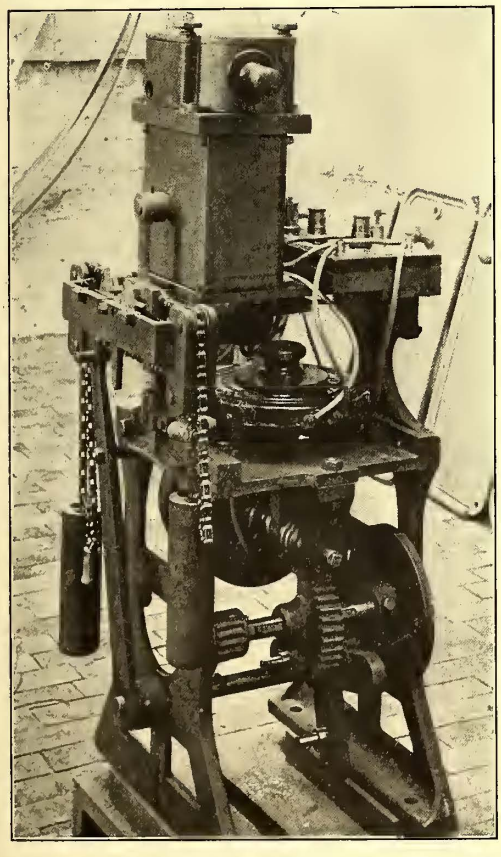


FIG. 2.—VIEW OF OPERATING MECHANISM OF THE AUTOMATIC SWITCH WITH COVER REMOVED

FIG. 3.—VIEW AT A JUNCTION, SHOWING AN INSTALLATION OF AN AUTOMATIC TRACK SWITCH. THE SWITCHING MECHANISM IS IN THE BOX NEXT TO THE POLE ON THE RIGHT

ORGANIZATION OF THE ELECTRIC CABLE COMPANY

The announcement is made that the Electric Cable Company, of Bridgeport, Conn., has been formed to succeed the Magnet Wire Company and the Peerless Electric Company, both of New York. The company is erecting a large model factory in Bridgeport, where it will manufacture magnet wire, field and armature coils and voltax, the new non-rubber insulation which is now on the market for the first time. The New York office will be at 42 Broadway. The officers of the company are: President, Edwin W. Moore; vice-president, Frederick H. Cowles; treasurer, J. Nelson Shreve, and secretary, H. S. Williston. The directors include Alfred Skitt, of New York; John Carstensen, of New York; G. Tracy Rogers, of Binghamton, N. Y.; George C. Edwards, of Bridgeport, Conn.; Russel A. Cowles, of New York; Edwin W. Moore, of New York; Frederick H. Cowles, of New York; J. Nelson Shreve, of New York, and H. S. Williston, of New York.

LONDON LETTER

(From Our Regular Correspondent.)

At the invitation of the G. B. Surface Contact Company, a party of journalists connected with the electrical press journeyed a few days ago down to the interesting old city of Lincoln, where this company has recently completed a contract for the Lincoln corporation for the equipment of its small tramway system with the G. B. surface-contact system. The day was a most enjoyable one in every way, Mr. Griffiths, who journeyed down with the party, taking good care of them until Lincoln was reached, where the party was joined by Mr. Bedell. The whole party then boarded one of the electric cars and made a successful trip out to the car sheds at the far end of the route, which is 1¾ miles long. Everyone expressed his entire satisfaction with the way in which the car operated, and great satisfaction was also expressed at the condition of the street, the contact studs being hardly visible, and certainly not protruding above the street to any extent whatever. After an inspection in the car sheds of the under portion of the car, particularly of the flexible skate and the electromagnets for operating the surface-contact system, a return trip was made to Lincoln, the car reaching a speed of 20 m.p.h. to 22 m.p.h., at which speed everything worked as smoothly as possible. A short visit was afterward made to the electric lighting works of the corporation, from which the tramways derive their power, after which a return was made to the Saracen's Head Hotel, where the party was entertained at dinner by Messrs. Griffiths and Bedell. A full description of the system will be found in this issue of the STREET RAILWAY JOURNAL.

It is with regret that we have to record this month the death of two gentlemen who have both been prominently before the public as interested in electric traction enterprises. It is almost unnecessary to mention the name of C. T. Yerkes, who for the past five or six years has been prominently before the public in connection with the various underground railways of London. Other writers in this journal have already borne testimony as to the great position he filled in the world of electric traction, but we cannot refrain in this, our London letter, from at least referring to the great work which he was the means of inaugurating in London. When Mr. Yerkes arrived in London this great city was sadly in need of better transportation facilities. Hours were consumed in getting about from district to district in London where minutes will suffice after the complete scheme of Mr. Yerkes is finished. The first step that Mr. Yerkes took was to associate himself with important English financiers, and then get a controlling interest in the Metropolitan District Railway Company, whose electrification scheme has just been successfully completed. After this followed the purchase of the Baker Street & Waterloo Railway, which enterprise, inaugurated some years previously, had almost fallen through from lack of capital and bad financing. Then followed the Charing Cross, Euston & Hampstead Railway tube, which will give transportation facilities most urgently required, together with the Brompton & Piccadilly and other tube railways. Perhaps another two years, or at least three years, will see the completion of this work, and it is a matter of universal regret that Mr. Yerkes was not spared to see the result of the immense work which he commenced and for which he will be remembered in London for many years to come.

The other death which has occurred in the electric traction circle is that of C. R. Bellamy, of Liverpool. Until quite recently Mr. Bellamy was in the best of health, but he had an unfortunate accident by which he suffered a severely sprained ankle, which necessarily confined him to the house. No one had the slightest idea, however, that anything was seriously the matter with Mr. Bellamy, but unfortunately some complication arose by which one of the arteries became clotted, and ultimately resulted in his very sudden death. Mr. Bellamy was a Londoner, and in his early life was interested chiefly in the development of gas, and as long ago as 1882 received an appointment in the gas department of the Liverpool corporation. In 1884 Mr. Bellamy was appointed superintendent of the lighting department, and in 1895 he was appointed the city lighting engineer, in which capacity he created a great reputation for himself and also for his city, which is generally acknowledged to be the best lighted city in the United Kingdom. It was in 1898 that Mr. Bellamy was brought into the service of the tramways, and it was under his régime that the whole conversion of the tramways was made from horse traction to electric traction. The tramway traffic in Liverpool has been enormous since that time, and the success of the tramways is too well known to be mentioned in detail here. Mr. Bellamy was also popular with the tramway employees and with all the other tramway officials with whom he frequently came in contact, and will be much missed for years to come in all conferences on tramway affairs.

One of the most important appointments which has recently been made in London is that of Sir George Gibb to the chairmanship of the Underground Electric Railways Company, a position made vacant by the death of Mr. Yerkes. It is perhaps not altogether inopportune to mention at this time that great and successful as the work of electrification has been, yet there have been a great many complaints from the traveling public, chiefly in regard to little matters which might just as well be obviated. It would appear as if it had been necessary for some time to have a strong railway man in charge, and no better appointment could possibly have been made than that of Sir George Gibb. He has had twenty-four years of experience in connection with one of the large steam railways, namely, the North Eastern Railway Company, which has also had one of its branch lines electrically converted within the past few years.

The work of constructing the new tramway system between Dundee and Monteith has now been completed, and recently the formal opening ceremony of the new tramway system took place. It will be remembered that J. G. White & Company, of London, secured the contract for the whole of this work, and it has been completed within the short time of six months. This tramway is a suburban one, and will undoubtedly do much to assist in the development of the Dundee suburbs and the neighboring boroughs. The system has been looked forward to for a long time in the district of Dundee and Broughty Ferry, and since the formal opening has been extremely well patronized.

As will be noticed in another column, a description is given of the electrification of the Belfast corporation tramways. This is practically the last of the big tramway systems in this part of the world to be converted from animal traction. There are now left no other cities of anything like similar magnitude which are not already electrically equipped. The whole work, as is well known, has been undertaken by the firm of J. G. White & Company, Ltd., who got the contract for everything, including track, overhead construction, cars, power house and other parts complete. It has been well carried out and to the entire satisfaction of the Belfast corporation officials. If any statistics were still wanting to prove that the electrification of a tramway system is a paying proposition, the statistics of the first few weeks of Belfast would be convincing. For December, 1904, before the electrification, there were 2,321,882 passengers, as against 3,705,872 passengers for December, 1905. Before electrification the receipts amounted in December, 1904, to £11,034 3s. 4d., whereas in December, 1905, the receipts amounted to £15,482 18s. 8½d., showing an increase of 1,383,990 passengers and £4,448 15s. 4½d. in receipts, proving once again that which is well known to all students of the tramway situation, that better traveling facilities and cheaper fares will lead to a tremendously increased traffic and largely increased receipts.

Before this is published the new shallow underground tramway of the London County Council will have been opened for public service. As is very well known now, this underground tramway commences, at the present moment, at the junction of Aldwych and Kingsway. The tramway is at this point about 20 ft. under the street level, but as it gets further north it descends near Holborn to a depth of about 31 ft., so as to avoid the sewers in that thoroughfare. It afterward ascends by a grade of 1 in 10 to a point at the junction of Theobalds Road and Southampton Row, where the system is continued to the Angel on the surface. Trial journeys have already been made in the subway and everything is now in complete working order, and has been duly passed by the Board of Trade. The cars will be of a somewhat different type to those commonly in service in England, as the tunnel has been made with only depth sufficient for a single-deck car, so that all the cars on this route will not have the double deck with which Englishmen are familiar.

Col. Druitt, Board of Trade inspector, has passed the Rochdale section of the Heywood corporation tramways, which couples up practically the whole of the electric tramways system in Lancashire. With this connecting link it will be possible to make a journey by tram from Rochdale to Liverpool, and by the construction of a track in the Todmodren district through connection between Halifax and Liverpool will be obtained.

The Ardrossan committee of Ayr County Road Board has been considering the proposal to lay tramways for Ardrossan and district, and has agreed that the County Council should not consent to the scheme till a satisfactory agreement has been made with the promoters. The committee is of opinion that the tramways would be a great boon to the people in the neighborhood of Stevenston, Saltcoats, Ardrossan and West Kilbride, and it looks upon the scheme as only the forerunner of other tramway schemes which might to some extent affect the different districts in the county.

The interim report of the British Electric Traction Company, Ltd., chronicles the total mileage of tramways, railways and omnibus routes as 439 miles, while the total traffic receipts of all the associated undertakings for the current year are estimated at £1,-

400,000, as compared with £1,264,000 for 1904. Though the company has sold its interests in several undertakings to local authorities and others, upon which the return for 1904 was about £12,000, the directors expect that the aggregate return for the current year upon the company's investments will be maintained.

The Underground Electric Railways Company, of London, has purchased for the Great Northern, Piccadilly & Brompton Railway thirty-six trains of six cars each, all steel construction, and similar to those now being received for the Baker Street & Waterloo Railway. The order has been divided equally between the Hungarian Railway Carriage & Machine Works, Ltd., at Raab, Austria, and Les Ateliers de Construction du Nord de la France, Blanc-Misseron, France.

An order has been placed with the American Car & Foundry Company (English branch), Manchester, for thirty trains of five cars each, all steel construction, for the Charing Cross, Euston & Hampstead Railway.

The Dublin United Tramways Company maintains its dividend at 6 per cent per annum for the fifth consecutive half-year, and again puts £4,000 to reserve, while adding £1,000 to insurance fund and setting aside £2,500 for maintenance in the current six months. A year ago £1,000 was transferred to accident fund, but no provision was made for maintenance. The carry forward is £7,107, against £6,848. The company has a capital of £1,500,000, and has a complete monopoly of the tramway business in the Irish capital.

A. C. S.

PARIS LETTER

(From Our Regular Correspondent.)

The managers of the Paris General Omnibus Company are continually protesting against what they consider an injustice of not being permitted to take off from regular service those lines of omnibuses which have become more or less of a burden to the company, by reason of the competition of the Paris Metropolitan lines. It is true that the company has keenly felt the effects of competition of the new lines of the Metropolitan, but during the last few weeks the receipts have shown a considerable increase as compared with those of a year or two ago, and this is traceable to the fact that increased means of traffic create traffic, as has been also noticeable in other large capitals. There are also a number of people who, if they have time, prefer to patronize the trams and buses of the surface companies in preference to the underground tunnels, where the air is at times quite nauseating and probably, to some extent, unhealthy. The Metropolitan Company, apparently, has found no good means of ventilating its tunnels satisfactorily.

The French protectorate of Tunis, which has hitherto not been blessed with traction schemes of any importance, is now receiving attention in France. There are three or four applications for concessions for tramways and light railways, and the journal "Official" has recently contained the usual declaration of public utility of a rather important installation in the town of Tunis and environs.

The Belgian Government, it is reported, has decided to build a high-speed electric line between Ostend and Aix-la-Chapelle, well-known pleasure resorts.

Attention has from time to time been called in this column to the possibilities offered by Italy for the development of electric traction. A French concern with a capital of 5,000,000fr. and debenture capital of 6,000,000fr. has just been formed in Paris for the exploitation in central Italy of various concessions for tramways and light railways, which may be guaranteed by either the government, the provincial or municipal authorities. This is quite a big enterprise, and will doubtless mean renewed activity in Italian traction matters in the near future.

M. V.

ANNUAL MEETING OF THE NORTH AMERICAN COMPANY

In accordance with the action taken at the annual meeting of the North American Company on June 21, 1905, at which the by-laws of the company were so amended as to provide that the annual meeting should thereafter be held on the fourth Wednesday in January, instead of the third Wednesday in June each year, the stockholders met on Jan. 24, to receive the report of the president and the treasurer and for the transaction of general business.

The company, as is generally known, controls through the ownership of stock a number of public utilities, the most important of which are the Milwaukee Electric Railway & Light Company, the Laclede Gas Light Company, of St. Louis, and the United Railways, of St. Louis. In his report President Wetmore discusses the general status of the company, referring from time to time at no little length to improvements in hand and to the general condition and prospects of the several companies controlled. Of especial interest is his reference to St. Louis after the fair. He says St. Louis has issued from its World's Fair period not only without depression, but with its business activities greatly stimulated and its confidence in its own destiny greatly enhanced. Prosperity, he says, is equally true of Racine and other cities and towns tributary to the Milwaukee properties of the company. As regards Detroit, he says its manufacturing is unprecedented.

In referring to the plans of the company for the development of the properties, he says that public utilities, if they are to be stable and profitable, should be administered so that they may not only meet the present demands of the communities in which they operate, with service of the highest kind, but also respond immediately to the growth of such communities and their business, however rapid it may be. He then outlines in a general way the improvement being made and those planned to be made to the subsidiary companies. Of interest are his statements regarding the improvements made to the property of the Milwaukee Electric Railway & Light Company. In that city has been erected a new power station which more than doubles the total output of the company three years ago. In addition to this, there has been completed a general office building and terminal station of great utility. This building was so planned that there are a storage room for 100 cars, supply and repair departments, a library, club rooms and many other facilities for the comfort, instruction and amusement of its employees, and a large convention hall and theater. Below is appended a summary of the report of the company for the year ended Dec. 31, 1905, a comparison being made with the previous year:

	1905	1904
Interest	$104,672	$44,835
Dividends	1,157,040	777,153
Other profits	116,901	156,252
Total	$378,613	$978,240
Deduct—		
Salaries, legal, etc.	$93,006	$73,719
Taxes	4,622	4,605
Dividends	1,252,997	840,833
	$1,350,625	$919,157
Balance	$27,988	$59,083

The general balance sheet as of Dec. 31, 1905, compares with that of the previous year as follows:

ASSETS

	1905	1904
Stocks	$29,916,745	$18,738,970
Bonds	541,333	184,258
Loans	1,933,397	339,065
Office and miscellaneous property	4,456	2
Accounts receivable	339,497	43,109
Cash	1,090,212	669,893
Total	$33,825,641	$19,975,298

LIABILITIES

Capital stock	$29,635,500	$17,000,000
Loans	.....	500,000
Dividends	2,274	72,414
Funds of constituent companies	883,004	411,140
Accounts payable	492,631	.....
Undivided profits	2,812,232	1,991,744
Total liabilities	$33,825,641	$19,975,298

NEW YORK, NEW HAVEN & HARTFORD RAILROAD GETS MORE LINES

It is authoritatively announced that the Consolidated Railway Company, acting for the New York, New Haven & Hartford Railroad, has purchased the Hartford, Manchester & Rockville Tramway Company, the Stafford Springs line and the rights to complete the Hartford & Worcester Street Railway. This will in no way affect the electrification of the present steam road between Hartford and Rockville, Conn. Work will be continued in electrifying the steam railroad as proposed in the original plan. Some of this work has already been completed on the line. Considerable delay was encountered, owing to the necessity of securing certain rights. These have now been obtained. The purchases which the company has just made give it an undisputed right to build a direct line from Hartford to Worcester. The cities and towns through which the lines of the Consolidated are operated are New Haven, Wallingford, Middletown, Norwich, New London, Willimantic, Killingly, Putnam and Thompson, Conn., and Webster, Oxford, Auburn and Worcester, Mass.

ANOTHER INTERURBAN RAILWAY FOR NORTHERN INDIANA

The State of Indiana, especially the northern portion, is fast becoming an important center for a network of interurban trolley lines which have been and are being built, interconnecting the towns along the Wabash Valley. The Winona Interurban Railway Company, Winona Lake, Ind., is the latest project of the kind to be undertaken.

This company is being promoted and will be controlled by the Winona Assembly, a Presbyterian organization, in the nature of a "Chautauqua" center for Presbyterians and others of that section.

The proposed line will run from Warsaw to Goshen, Ind., about 27 miles, for which the right of way has been acquired and the grading for the entire line completed. The line is located in a portion of two counties which, by action already taken by popular vote, are now collecting taxes appropriate for a subsidy.

The Allis-Chalmers Company, of Milwaukee, will furnish the electrical equipment for the proposed line, including equipments, power house and machinery, through the Electrical Installation Company, of Chicago, in charge of the actual construction and installation. The Winona Assembly organization is understood to have expended over $3,000,000 on grounds and buildings, to which additions are constantly being made. The permanent population at Winona is about 1200, while the transient population during the past summer amounted to over 300,000 visitors. It is expected that the line will be in operation by April.

The equipment specified will consist of two Allis-Chalmers cross-compound condensing engines to drive two 600-kw Allis-Chalmers alternators, 25-cycle; six quadruple 75-hp motor equipments, one 300-kw alternator, three 300-kw rotary converters with transformers, reactance coils, etc., and the usual auxiliary apparatus for substation equipment.

TERMS OF NEW YORK TRACTION MERGER OFFICIALLY ANNOUNCED—BELMONT TO BE PRESIDENT

Andrew Freedman, Thomas P. Fowler, Cornelius Vanderbilt, Gardiner M. Lane, Edward J. Berwind and John D. Crimmins, acting as a committee representing the stockholders of the Interborough Rapid Transit Company, the Metropolitan Street Railway Company and the Metropolitan Securities Company, of New York, fixed on Friday, Jan. 26, the exact terms of the merger by which the elevated, subway and surface lines in Manhattan and Bronx Boroughs will be brought under one management. It is required that two-thirds of the outstanding Interborough stock, two-thirds of the outstanding Metropolitan Street Railway stock, and one-half of the outstanding Metropolitan Securities stock be deposited with either August Belmont & Company or the Morton Trust Company. As soon as two-thirds of the required amount of stock is deposited the Interborough-Metropolitan Company may issue, according to the agreement, these securities:

$55,000,000 5 per cent cumulative preferred stock.
$100,000,000 common stock.
$70,000,000 4½ per cent collateral trust gold bonds.

Upon its issue all the common stock will be deposited under a voting trust agreement for a term of years. The voting trustees are August Belmont, Thomas F. Ryan, Cornelius Vanderbilt, Peter A. B. Widener and Walter G. Oakman. This voting trust will come to an end only when the trustees so determine.

The new securities will be exchanged for the old on the following basis:

For each share of stock of the Interborough Rapid Transit Company deposited under the call for deposit, (1) $200 face amount of collateral trust bonds, (2) $99 par amount of common stock (trust certificates).

For each share of stock of the Metropolitan Securities Company ($75 paid in) deposited under the call for deposit, $93.50 par amount of common stock (trust certificates).

For each share of stock of the Metropolitan Street Railway Company, (1) $100 par amount of preferred stock, and (2) $55 par amount of common stock (trust certificates).

The preferred stock will be entitled to preferential dividends from April 1, 1906, at the rate of 5 per cent a year, payable quarterly; it will be preferred also as to capital. The collateral trust bonds will be secured, under an agreement with the Windsor Trust Company as trustee, by the pledge and deposit of all the shares of the Interborough Rapid Transit capital stock which may be acquired by the new company. They will be issued only against this deposit and pledge, at the rate of $1,000 in bonds for each five shares of stock deposited and pledged. The bonds will mature April 1, 1956; the interest, at the rate of 4½ per cent, will be payable semi-annually in New York without deduction for any tax which the company may have to pay on the bonds, because of any future State or United States law.

August Belmont & Company subscribe for $3,000,000 of the preferred stock and pay for it, at par, in cash. And according to the agreement (which contemplates the issue by the Interborough-Metropolitan Company of its entire capital stock) August Belmont & Company will receive $8,700,000 common stock; for this the firm agrees to pay into the treasury of the company $2,250,000 in cash, and also to pay all expenses in connection with the organization and in connection with its acquisition of the stock of the three merged companies.

These expenses will include incorporation fees, transfer taxes, bankers' commissions, trust company charges, State taxes of all kinds, and charges and compensation of committee and counsel. Assuming the common stock to be roughly valued at 60, the $8,700,000 common stock would yield, at the present market value, some $5,200,000. With $2,250,000 paid into the treasury in cash, the remaining $2,250,000 is left for expenses and profits.

Walter G. Oakman has been elected president; John B. McDonald, vice-president, and W. H. Barnum treasurer of the Interborough-Metropolitan Company, which is to act as the holding company in the merger. These officers are regarded as temporary, to hold the positions until the details of the organization are completed and the securities of the traction corporations taken over. August Belmont will probably be elected president of the permanent organization.

TUNNEL BIDS IN BOSTON

In about a month the Boston Transit Commission will invite bids for the construction of the section of the Washington Street tunnel from a point about half-way between State Street and Cornhill to Hanover Street. The section will be about 800 ft long. Rapid progress has been made on the section under State Street, and two of the contractors will probably collect bonuses of $50 per day from the Commission for finishing their work ahead of time. The tunnel is now completed south of Franklin Street, and between Franklin and State Streets the walls are set and the roof laid. The tunnel structure is completed under Newspaper Row, the remaining work at this point being the laying of the roadbed for the lower track, and the extension of a concrete platform over this track from Milk Street to State Street. The underground passage under Water Street, from the Post Office, is also completed, except for the stairway connection at the Post Office end and the tunnel platform.

MEETING OF NEWMAN INTERESTS AT BIRMINGHAM, ALA.

The Newman Properties Association, composed of officials of the various electric railway and lighting properties in the South controlled by the Newman interests of New York City and New Orleans, held a three days' convention at Birmingham, Ala., Jan. 23, 24 and 25. The meeting was attended by about seventy-five delegates, comprising the presidents, managers, superintendents, auditors, claim agents and master mechanics of the different Newman companies, including those at Nashville, Tenn.; Little Rock, Ark.; Knoxville, Tenn.; Memphis, Tenn.; Houston, Tex.; Birmingham, Ala., and representatives from the New York office. The conference was held for the purpose of discussing subjects of interest to all the roads in the association, and making plans for improving and bettering the properties. At the closing session the following officers were elected for the ensuing year: President, Robert Jemison, president of the Birmingham Railway, Light & Power Company; vice-president, C. O. Simpson, general manager of the Little Rock Railway & Light Company, of Little Rock, Ark.; secretary, H. P. Bunn, auditor of the Knoxville Railway & Light Company, of Knoxville, Tenn.

FENDERS IN LOS ANGELES

The Voters' League of Los Angeles announced, after a conference with William E. Dunn, attorney for the Huntington street railway interests in Los Angeles, that it had secured a promise that all the Huntington cars in Los Angeles will be equipped with such fenders as it has been advocating. Mr. Dunn promised for Mr. Huntington compliance with the terms of a certain fender ordinance, excepting so far as it prohibits the hauling of freight through the streets of Los Angeles. Samples of the Eclipse and Consolidated fenders will be sent to Los Angeles for tests. If these tests prove satisfactory, the City Council will be asked to adopt an ordinance covering the specifications. The provisions of the ordinance as to speed at crossings have also been accepted by the street railways. This will limit cars to 4 m.p.h. at crossings in down-town districts, and 8 m.p.m. in the outlying portions of the city.

ORGANIZATION OF TWO FIRE INSURANCE COMPANIES

Announcement has just been made of the organization by the same interests of the American Railway Insurance Company and the Associated Railway Companies' Insurance Company, both of Cleveland, Ohio, especially for the purpose of insuring electric railway and light properties. Each has a capital stock of $200,000 and a surplus of $300,000. The promoters and incorporators are Horace E. Andrews, president of the Cleveland Electric Railway Company; Henry A. Everett, president of the Northern Ohio Traction & Light Company; A. E. Akins, vice-president of the Cleveland Southwestern Traction Company; Warren S. Bicknell, president Lake Shore Electric Railway Company; Chas. W. Wason, president Cleveland, Painesville & Eastern Railway Company; C. G. Goodrich, vice-president Twin City Rapid Transit Company; J. C. Hutchins, president Detroit United Railway Company; John J. Stanley, general manager Cleveland Electric Railway Company; H. J. Davies, secretary of the Cleveland Electric Railway Company and director of the Factory Mutual Insurance Company; T. H. Hogsett, attorney, director of the Factory Mutual Insurance Company, and Henry N. Staats, manager of the Associated Railway & Light Companies' Insurance Inspection & Survey Bureau, which has been organized in connection with the two companies mentioned.

The organization of these two stock companies was the result of the movement organized some time ago by a number of railway companies toward the establishment of a mutual insurance company to insure electric railway and lighting risks. It was considered advisable for the mutual company not to commence business until $20,000,000 in underwriting value had been secured, and to confine the underwriting exclusively to protected risks. As comparatively few risks at the present time can be included in the term "protected," it was decided advisable by Mr. Davies and his associates to organize for present purposes the two stock companies mentioned, and for them to write both protected and unprotected risks until the number of protected risks available in the country would warrant the commencement of business in a mutual way. The new companies believe that by paying no commissions and confining their business to electrical properties they can materially reduce the cost of insurance to operating companies.

In December, 1904, Mr. Davies, secretary of the Cleveland Electric Railway Company, mailed to every street railway company in the United States and Canada a letter, requesting a report of the amount of money paid for fire insurance in each of the past ten years, the amount of losses sustained, and the amount actually recovered from insurance companies. Reports were received from about 420 companies and covering the last ten years. They indicated that the total premiums paid by these companies was $6,049,641; the total losses, $1,971,806, or 32.59 per cent of the premiums paid, and that the amount recovered was $1,673,336, or 27.66 per cent of the premiums paid. According to some figures compiled by J. H. Neal from a number of the New England street railway companies during the last ten years show premiums paid, $1,016,524 and amounts recovered, $239,170, or 23.5 per cent of the premiums.

The new companies will have their headquarters in the Citizens' Building, Cleveland.

A NEW ELECTRIC LINE FOR THE WILLAMETTE VALLEY, OREGON

Although the Willamette Valley, of Oregon, is one of the richest and largest agricultural districts in the United States, its only outlet for freight shipments is by way of the Southern Pacific Railroad. Hitherto it has been impossible to get railroad franchises for a long line in this territory, which would be able to secure a portion of the profitable freight and passenger business to Portland. Recently, however, the Oregon Electric Railway Company was organized to build a single-track line from Salem to Portland, a distance of 50 miles. After overcoming many obstacles, Barstow & Chambers, engineers, of New York and Portland, succeeded in getting all the necessary franchises and rights of way in Salem and all other places along the proposed route excepting Portland, where a franchise application is now pending in the name of a subsidiary company, known as the Willamette Valley Traction Company. The engineering firm mentioned, of which W. S. Barstow is a member, operates for Eastern capitalists all the public service properties in Salem, but the owners of the Salem corporations are in no wise affiliated with the new line, except that some agreement will be reached later as to running rights in that city. The proposed line will extend from Portland south to Salem crossing the Willamette River about 20 miles from Portland. At this point a single-track bridge will be built, capable of carrying 100-ton locomotives. Including the approaches, this bridge will be 1100 ft. long and be 70 ft. above the river at its highest point. The largest part of the construction is to be 70-lb. single track, laid on rock ballast, and running over grades which will not exceed 2 per cent. From these details it will be noted that the line will be capable of carrying heavy trains of freight. It is intended to carry on a regular passenger, freight and express business. The freight business, in fact, will form a very important feature of this line. Where the road enters Portland, connection will be made with the freight yards of the Southern and the Northern Pacific Railroads. The power for operation will be secured from the Portland General Electric Company's power plant at Oregon City. Owing to the fact that the standard frequency of this station is 33 cycles, which is considerably higher than any frequency used on American single-phase railway motors, the engineers of this line have not yet come to a decision as to what type of electrical apparatus to adopt. It is likely, however, that some form of single-phase motor will eventually be accepted.

The present service given by the Southern Pacific to this portion of the Willamette Valley comprises three trains per day, which cover the distance in about three hours. Not only will the new electric line parallel a part of the Southern Pacific, but about 12 miles of branches will be built as feeders to the main line. As an indication of the freight possibilities of this district, it is stated that last year the hop crop in the Willamette Valley amounted to about $10,000,000.

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED JAN. 23, 1906

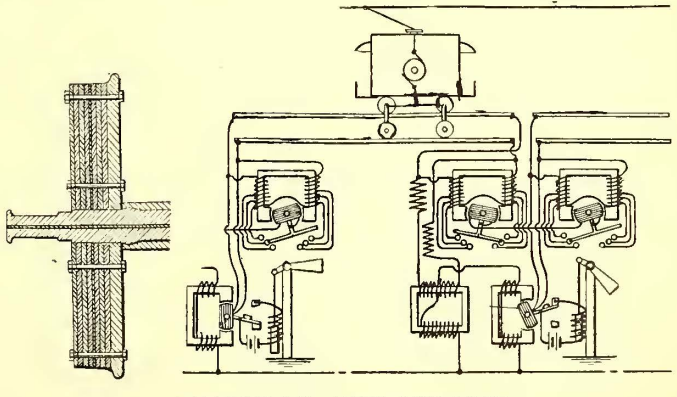
810,395. Hanging Strap for Passenger Vehicles; John S. Collins, New York, N. Y. App. filed March 6, 1905. An advertising frame in the shape of an inverted pyramid is incorporated with a hanging strap.

810,433. Tongue Switch; Ernest B. Prior, Brooklyn, N. Y. App. filed June 29, 1905. A body structure having an integral overhanding portion at the heel extending forward of the tongue-pin, and having an aperture therethrough to permit the insertion and withdrawal of the pin.

810,458. Railroad Spike; Rowland Anderson, Chihuahua, Mex. App. filed May 12, 1905. A railroad spike having a stem or shank adapted to enter a cross-tie beneath the rail thereon, and a lateral extension of said stem forming a shoulder above which the rail is adapted to engage.

810,493. Rail-Joint Chair; Daniel Mersgelder, Cincinnati, and William L. Mersfelder, Norwood, Ohio. App. filed Oct. 25, 1905. A base-plate having ribs on opposite edges to receive between them the base of two adjoining rail ends and wedges adapted to act against the under side of this plate to hold it against the under side of the rail ends.

810,525. Combined Car Axle and Wheel Structure; Lewis P. Fertig, Chicago, Ill. App. filed April 3, 1905. Combines in the construction of car axles and wheels other metals having a different rate and amplitude of vibrations, and in such a manner that the vibrations of the one metal shall neutralize the vibrations of the other to a degree reducing the noise therefrom to a minimum.



PATENTS NO. 810,525 AND 810,687

810,558. Car Seat; Allen E. Ostrander, Paterson, N. J. App. filed July 26, 1905. Provides a car seat of metal and so combined with the car body as to increase the strength thereof and obviate the necessity of bracing.

810,609. Electrofluid Pressure Mechanism for Operating Railroad Appliances; Walter J. Bell, Los Angeles, Cal. App. filed Dec. 1, 1903. A fluid pump located at the various switches serves to continuously maintain pressure in a fluid reservoir. A pair of

solenoids have poppet-valve connections for opening and closing the pipes from said reservoir to the cylinder which operates the switch point.

810,674. Vehicle Motor Suspension Mechanism; Frank B. Rae, Detroit, Mich. App. filed Sept. 7, 1905. A plurality of vehicle-supporting journal boxes on the driving axle, a tube connecting two adjacent boxes and enclosing said axle, and a motor having its axle end rotatably mounted upon said tube and its free end yieldingly supported from some other portion of the vehicle.

810,687. System of Automatic Signaling for Electric Railways; Fitzhugh Townsend, New York, N. Y. App. filed Nov. 10, 1905. An inductive bond system in which the bonds for the separate rails have means for compensating for the effect of different currents therein by means of automatically varying the resistance of said bond in inverse proportion to the power current in the rails.

810,705. Block Signal System for Electric Railways; Abram L. Bower, Boyertown, Pa. App. filed Jan. 10, 1903. A turn-out system having insulated track sections at the turn-outs, which make circuits to set the signals alternately by means of a ratchet wheel, which is intermittently stepped around by an electromagnet.

810,762. Fender for Cars and Other Vehicles; George Hipwood, Laconia, N. H. App. filed June 24, 1905. The fender is raised and lowered by a foot-controlled ratchet having a chain connection with the fender.

810,763. Fender for Cars and Other Vehicles; George Hipwood, Laconia, N. H. App. filed June 24, 1905. Details of construction.

810,831. Dust Collector for Cars; George F. Weir, Elkhart, Ind. App. filed June 28, 1905. Provides for the collection of dust thrown up by the car wheels, and consists of a chute laterally arranged outside of the truck wheels and a dust-conducting pipe leading from the chute throughout the entire length of the train to thereby discharge the dust at the rear end thereof.

PERSONAL MENTION

MR. BERNARD CAHN, at one time prominently connected with traction developments in Baltimore and a director of the Baltimore City Passenger Railway Company, is dead.

MR. E. B. KIRK, vice-president and general manager of the Winnebago Traction Company, Oshkosh, Wis., has been elected vice-president of the Northwestern Electrical Association.

MR. J. F. CAMERON has been appointed purchasing agent of the South Chicago City Railway Company. Mr. Cameron has been identified with the company for eleven years, and during the greater portion of this period he has had direct charge of the purchasing and handling of supplies.

MR. H. C. MACKAY, auditor of the Milwaukee Electric Railway & Light Company, has resigned as a member of the committee on the standard classification of accounts of the Street Railway Accountants' Association of America. Mr. F. R. Henry, of the St. Louis Transit Company, has been appointed his successor.

MR. J. F. JOHNSON has resigned as master mechanic of the Fort Smith Light & Traction Company, of Fort Smith, Ark., to engage in business for himself in Fort Smith. He will be succeeded by Mr. Frank Wheeler, of Elkhart, Ind. Mr. Johnson was connected with the Light & Traction Company for fifteen years.

MR. F. J. STOUT, for a number of years general superintendent of the Lake Shore Electric Railway, has been promoted to be general manager of that property. Mr. Stout is a well-known and most successful operating man, and the remarkable gains made by the Lake Shore Electric during the past year were due largely to his efforts.

MR. ROBERT P. LEE, of Pittsfield, Mass., assistant superintendent of the Berkshire Street Railway Company, has been appointed superintendent of the Meriden lines of the Consolidated Street Railway Company. He succeeds Mr. Warren P. Bristol, who resigned to become manager of the Hartford line of the Consolidated Company.

MR. R. W. DAY, former claim agent for the Wilkesbarre & Wyoming Valley Traction Company, has been appointed general manager of the Northern Electric Street Railway Company, which is about to build a line from Scranton to Factoryville, passing through Clark's Summit, Chinchilla, Dalton and La Plume. The line is to be eventually extended to Lake Winola and Tunkhannock.

MR. E. W. OLDS, of Milwaukee, has resigned from the insurance committee of the American Street & Interurban Railway Association. Mr. W. Caryl Ely has appointed in his place Mr. R. B. Stearns, superintendent of the Northwestern Elevated Railway Company, of Chicago. The committee now consists of Mr. H. J. Davies, of Cleveland, and Mr. T. C. Penington and Mr. R. B. Stearns, of Chicago.

MR. GEORGE FLETT, managing director of Dick, Kerr & Company, Ltd., of London and Preston, England, sailed for the East a few days ago. As is well known, the firm of Dick, Kerr & Company constructed the system of tramways in Calcutta, Mandalay, Singapore and Hong Kong, and is just about completing a large system of tramways in Tokil. While Mr. Flett is really going on this trip, which will eventually end by being a tour round the world, for pleasure and health, he will visit all the places en route, stopping at the United States on his way home.

MR. W. A. McWORTER, master mechanic of the Birmingham Railway, Light & Power Company, of Birmingham, Ala., has been made assistant superintendent of the railway department for the company, and he will hereafter fill the two positions. His advancement to executive duties in connection with his mechanical work is a well-merited recognition of his services. Mr. McWorter was for a number of years connected with the mechanical department of the street railway system of Atlanta, Ga., and previous to that was master mechanic of the Savannah Electric Company at Savannah, Ga.

MR. J. R. HARRIGAN, for a number of years general manager of the Columbus, Buckeye Lake & Newark Traction Company and the Columbus, Newark & Zanesville Railway, has resigned to become general manager of the Canton-Akron Railway system, which embraces the Canton-Akron Railway, the Canton-New Philadelphia Railway and the Tuscarawas Traction Company. These properties are owned by Tucker, Anthony & Company, of Boston, who formerly owned the Columbus properties mentioned. Mr. Harrigan was largely instrumental in making the Columbus, Buckeye Lake & Newark Traction Company one of the best paying interurban propositions in the country.

MR DWIGHT W. BLAKESLEE, of New Haven, Conn., well known throughout the East and Central West as a railroad contractor and promoter, was killed by a railroad train on the New York, New Haven & Hartford Railroad near New Haven a few days ago. Mr. Blakeslee was, at the time of the accident, inspecting some work along the road for which he had the contract, and had climbed onto the railroad track from the ditch into which he had gone to give orders. Suddenly he felt the ground give way on which he stood, and in order to save himself from falling back into the excavation pitched forward. In so doing he fell across the railroad in front of an express train.

MR. FREDERICK R. SLATER, who was principal assistant to Mr. L. B. Stillwell while the latter was electrical director of the Interborough Rapid Transit Company, of New York, has resigned from that company and has opened an office as consulting electrical engineer at 100 Broadway, New York. Mr. Slater is a graduate of Cornell University of the class of 1894. After completing his course in electrical and mechanical engineering at that institution he was engaged for a short time in the design of the power station of Cornell University, after which he left Ithaca to assist in the design of the new shops of the Otis Elevator Company. On the outbreak of the recent war with Spain he decided to engage in military service, and served as adjutant in the First Regiment of United States Volunteer Engineers. After the close of the war he joined the forces of the Manhattan Elevated Railway Company, of New York, which was then converting its lines from steam to electricity, and became assistant to the electrical engineer, Mr. Hugh Hazelton. He continued with the Manhattan Company until its electrification was completed, and then accompanied Mr. Stillwell from the Manhattan Company to the work of the electrification of the subway in New York.

MR. W. G. HOVEY has been appointed construction manager of the General Railway Signal Company, in charge of the installation of the new signal system for the electrical zone of the New York Central & Hudson River Railroad Company, the contract for which was recently awarded to the General Railway Signal Company. Mr. Hovey, who is a native of Maine, 45 years of age, has had an extensive experience in signal work, beginning as lineman in the signal department of the New York, New Haven & Hartford Railroad in 1889. A year later he went to the Hall Signal Company as foreman of installation. In 1892 Mr. Hovey went with the Chicago & Northwestern Railroad, as superintendent of signals, and retained this position for eight years, when he was selected by the Taylor Signal Company as superintendent. He was later appointed Eastern agent of this company and afterwards resident manager of the General Railway Signal Company upon the acquisition by the latter company of the business of the Taylor and Pneumatic Signal companies. Mr. Hovey is succeeded as resident manager in New York by Mr. H. M. Sperry, well known for his connection with the Union Switch & Signal Company and the installation of the alternating-current signal system in the rapid transit subway in New York. Mr. Sperry will assume his new duties Feb. 1.

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.

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., Dec. '05	84,985	45,151	39,834	23,411	16,423
	1 " " '04	76,615	41,537	35,078	24,514	10,564
	12 " " '05	963,187	516,390	446,797	276,744	170.053
	12 " " '04	895,731	486,980	408,751	273,664	135,087
AURORA, ILL.						
Elgin, Aurora & Southern Tr. Co	1 m., Nov. '05	41,123	23,441	17,682	9,333	8,349
	1 " " '04	36,380	21 872	14,508	9,333	5,175
	5 " " '05	224.046	116,923	107,123	46,506	60,617
	5 " " '04	201,586	107,800	93,786	46,506	47,280
BINGHAMTON, N. Y.						
Binghamton Ry. Co	1 m., Dec. '05	22,465	11,808	10,657	7,261	3,396
	1 " " '04	20,946	10,414	10,531	7,082	3,450
	6 " " '05	153,536	75,734	77,803	43,389	34,414
	6 " " '04	137,628	69,873	67,756	41,925	25,830
CHICAGO, ILL.						
Aurora, Elgin & Chicago Ry. Co	1 m., Nov. '05	48,292	28,138	20,153	------	------
	1 " " '04	35,454	19,154	16,300	------	------
	5 " " '05	316,839	156,742	160,096	------	------
	5 " " '04	237,024	116,485	120,539	------	------
Chicago & Milwaukee Elec. R. R. Co	1 m., Dec. '05	66,584	24,199	42,384	------	------
	1 " " '04	39,427	17,520	21,907	------	------
	12 " " '05	594,875	244,552	350,323	------	------
	12 " " '04	464,655	179,038	285,618	------	------
CLEVELAND, O.						
Cleveland, Painesville & Eastern R.R. Co	1 m., Dec. '05	19,841	*10.144	9,698	6.799	2,899
	1 " " '04	17,093	*10,692	6,401	6,638	†237
	12 " " '05	245,089	*141,270	103,819	80.830	22,989
	12 " " '04	225,751	*136,021	89,730	80,250	9,480
Cleveland & Southwestern Traction Co.	1 m., Dec. '05	47,540	26,548	20,992	------	------
	1 " " '04	37,071	22,435	14,636	------	------
	12 " " '05	543,227	314,254	228,973	------	------
	12 " " '04	475,362	293,615	181,746	------	------
DETROIT, MICH.						
Detroit United Ry	1 m., Dec. '05	444,346	*242,621	201.725	98,696	103,029
	1 " " '04	392,757	*239 690	154,067	93.619	60,448
	12 " " '05	5,169,638	*3011522	2,128,116	1,113,293	1,014,823
	12 " " '04	4,584,582	*2763092	1,821,490	1,075,786	745,704
EAST ST. LOUIS, ILL.						
East St. Louis & Suburban Co	1 m., Dec. '05	128,511	57,694	70,817	------	------
	1 " " 04	115,403	45,650	69,753	------	------
	12 " " '05	1,351,576	597,452	754,124	------	------
	12 " " '04	1,363,549	596,157	767,392	------	------
FT. WAYNE, IND.						
Ft. Wayne & Wabash Valley Tr. Co	1 m., Nov. '05	80,474	46,926	33,548	------	------
	1 " " '04	67,109	43,849	23,260	------	------
	11 " " '05	862,167	530,501	331,666	------	------
	11 " " '04	761,969	491,746	270,223	------	------
FT. WORTH, TEX.						
Northern Texas Tr. Co	1 m., Nov. '05	66,271	36,247	30,023	9,938	20,086
	1 " " '04	47,634	30,621	17,013	9,100	7,913
	12 " " '05	658,906	387,077	271,829	117,372	154,457
	12 " " '04	551,716	330,244	221,472	107,911	113,560
GALVESTON, TEX.						
Galveston Electric Co.	1 m., Nov. '05	22,522	13,757	8,765	4,167	4,598
	1 " " '04	19,628	------	------	------	------
	7 " " '05	171,993	103,320	68,673	29,167	39,506
	7 " " '04	161,682	------	------	------	------
HANCOCK, MICH.						
Houghton County St. Ry. Co	1 m., Nov. '05	15,215	11,067	4,148	3,749	399
	1 " " '04	16,692	10,783	5,909	3,324	2,585
	11 " " '05	150,312	156,503	†6,291	39,870	†46,161
	11 " " '04	182,429	121,920	60,509	37,111	23,398
HOUSTON, TEX.						
Houston Electric Co.	1 m., Nov. '05	52,236	33,572	18,664	9,049	9,616
	1 " " '04	42,983	26,246	16,738	8,284	8,454
	12 " " '05	509,008	307,211	201,796	105,025	96,771
	12 " " '04	348,785	315,997	32,787	96,176	†63,389
HUDSON, N. Y.						
Albany & Hudson R. R. Co	1 m., Dec. '05	25,241	*20,018	5,223	------	------
	1 " " '04	22,716	*21,273	1,443	------	------
	12 " " '05	320,281	*253,958	76,323	------	------
	12 " " '04	292,337	*219,029	73,308	------	------
JACKSONVILLE, FLA.						
Jacksonville Elec. Co.	1 m., Nov. '05	22,423	15,216	7,207	3,391	3,816
	1 " " '04	23,248	14,163	9,085	3,018	6,067
	11 " " '05	282,018	165,775	116,243	34,531	81,712
	11 " " '04	263,929	161,399	102,530	33,784	68,746
MILWAUKEE, WIS.						
Milwaukee El. Ry. & Lt. Co	1 m., Dec. '05	400,905	138,565	262,341	83,087	179,254
	1 " " '04	353,307	136,263	217,044	82,072	134.973
	12 " " '05	3,348,696	1,551,463	1,797,233	931,016	866,217
	12 " " '04	3,285,378	1,592,414	1,692,964	916,460	776,505
Milwaukee Lt., Ht. & Tr. Co	1 m., Dec. '05	78,464	19,561	58,903	22,807	36,096
	1 " " '04	68,242	17,102	51,140	17,949	33,191
	12 " " '05	639,128	252,557	386,572	255,314	131,258
	12 " " '04	492,228	216,964	275,264	203,731	71,533
MINNEAPOLIS, MINN.						
Twin City R. T. Co	1 m., Nov. '05	417,218	190,360	226,859	113,208	113,650
	1 " " '04	354,202	162,704	191,497	97,308	94,189
	11 " " '05	4,320,887	1,961,448	2,359,440	1,113,425	1,246,015
	11 " " '04	3,930,440	1,843,111	2,087,330	1,011,749	1,075,571
MONTREAL, CAN.						
Montreal St. Ry. Co	1 m., Dec. '05	236.946	161,995	74,950	22,611	52,340
	1 " " '04	211,283	146,821	64,463	18,475	45,988
	3 " " '05	719,369	457,304	262,066	65,747	196,318
	3 " " '04	638,114	402,307	235,808	56,293	179,515
OAKLAND, CAL.						
Oakland Traction Consolidated	1 m., Nov. '05	124,131	64.369	59,762	34,610	25,153
	1 " " '04	109.065	56,232	52,833	26,525	26,308
	11 " " '05	1,310,096	673,020	637.076	357,929	279,147
	11 " " '04	1,146,982	598,820	548,162	292,024	256,138
San Francisco, Oakland & San Jose Ry. Co	1 m., Nov. '05	46 822	21,077	25,745	13,425	12,320
	1 " " '04	41,389	16,259	25,129	11,108	14,021
	11 " " '05	485,964	214 325	271,638	146,415	125,224
	11 " " '04	377,511	163,623	213,887	99,440	114,447
OLEAN, N. Y.						
Olean St. Ry. Co	1 m., Nov. '05	10,009	5,159	4,850	2,554	2,296
	1 " " '04	8,894	4,611	4,283	2,631	1.651
	5 " " '05	58,609	28,519	30,089	13,282	16,808
	5 " " '04	51,941	25,606	26,334	13,156	13,178
PEEKSKILL, N. Y.						
Peekskill Lighting & R.R. Co	1 m., Nov. '05	10,125	*5,516	4,609	------	------
	1 " " '04	8,581	*5,477	3,103	------	------
	5 " " '05	56,658	*28,687	27,972	------	------
	5 " " '04	51,187	*27,254	23,933	------	------
PHILADELPHIA, PA.						
American Rys. Co	1 m., Dec. '05	130,422	------	------	------	------
	1 " " '04	114,429	------	------	------	------
	6 " " '05	848,957	------	------	------	------
	6 " " '04	750,681	------	------	------	------
ROCHESTER, N. Y.						
Rochester Ry. Co	1 m., Dec. '05	167,905	96,361	71,544	25,998	45,546
	1 " " '04	142,224	75,535	66,689	26,834	39,855
	12 " " '05	1,787,858	973,476	814,383	332,133	482,250
	12 " " '04	1,499,719	824,490	675,228	319,970	355,257
ST. LOUIS, MO.						
United Railways Co. of St. Louis	1 m., Dec. '05	730,462	361,714	368,748	265,417	103,331
	1 " " '04	685,463	386,437	299,026	240,783	58,243
	12 " " '05	8 460,016	4,414,866	4,045,150	3,291,418	753,732
	12 " " '04	9,977,564	5,263,837	4,713,727	2,933,522	1,780,205
SAN FRANCISCO, CAL.						
United Railroads of San Francisco	1 m., Nov. '05	604,686	------	------	------	------
	1 " " '04	567,673	------	------	------	------
	11 " " '05	6,430,348	------	------	------	------
	11 " " '04	6,075,112	------	------	------	------
SAVANNAH, GA.						
Savannah Electric Co.	1 m., Nov. '05	50,420	28,413	22,007	11,155	10,852
	1 " " '04	45,635	26,378	19,257	10,552	8,705
	12 " " '05	580,544	343,357	237,187	127,342	109,845
	12 " " '04	540,833	307,909	232,924	126,024	106,901
SEATTLE, WASH.						
Seattle Electric Co	1 m., Nov. '05	227 852	147,632	80,220	22,139	58,081
	1 " " '04	200 607	147,972	52,636	24,974	27,662
	12 " " '05	2,538,852	1,668,781	870,071	293,053	577,018
	12 " " '04	2,306,100	1,586,266	719,833	286,500	433,333
SYRACUSE, N. Y.						
Syracuse R. T. Co	1 m., Nov. '05	82,748	46,591	36,157	20,540	15,618
	1 " " '04	69,998	40,291	29,706	20,337	9,369
	5 " " '05	419,172	231,711	187 461	102.315	85,146
	5 " " '04	361,230	202,933	158,348	101,467	56,881
TERRE HAUTE, IND.						
Terre Haute Tr. & Lt. Co	1 m., Nov. '05	55,459	33,883	21,576	10 429	11,147
	1 " " '04	49,308	29,171	20,137	9,222	10,916
	12 " " '05	620,768	407,350	213,418	120,652	92,766
	12 " " '04	562,883	370,900	191,982	114,132	77,850
TOLEDO, O.						
Toledo Rys. & Lt. Co	1 m., Nov. '05	164,418	*86 389	78,029	42,825	35,204
	1 " " '04	146,759	*77,037	69,722	41,626	28 096
	11 " " '05	1,737,711	*888,296	849,415	467,846	381,569
	11 " " '04	1,586,904	*845,372	741,532	458,181	283,351
YOUNGSTOWN, O.						
Youngstown-Sharon Ry. & Lt. Co	1 m., Nov. '05	50,440	*24,379	26,061	------	------
	11 " " '05	492,290	*260,762	231,528	------	------

NEWS OF THE WEEK

CONSTRUCTION NOTES

HUNTSVILLE, ALA.—It is understood that, failing to get the Nashville & Huntsville Railroad, the people of Shelbyville and Fayetteville, Tenn., will raise money to build an electric railway to connect the three places. There is a demand for the line, and it would develop a fine agricultural and timber section. There is abundant water power to be had hard by. R. E. Pettus, of Huntsville, is looking into the matter for the Chamber of Commerce of his city.

FORT SMITH, ARK.—The City Council has granted to the Interurban Electric Company an extension of one year in which to begin work, making the third extension since the company was incorporated two years ago. E. B. Miller, of the Commercial Club, has interested Memphis capital in the enterprise. The work is to be commenced within twelve months, and 3 miles are to be completed eight months thereafter. The company has a charter for 12 miles of road within the city limits and right of way through the other cities of the county, the round-trip distance from Fort Smith being about 50 miles.

HARRISON, ARK.—An agreement has been reached between the City Council and Mr. Quigley for an electric light, waterworks and electric railway. It is proposed to construct a line from Harrison to Bergman, the nearest point on the new White River line, 10 miles from this place.

FRESNO, CAL.—The Fresno Traction Company, A. J. Wiskon, manager, has been granted a franchise covering several lines, and the F Street Road will be the first constructed. The company will co-operate with the Southern Pacific Railroad in the construction of a three-tube conduit subway that will cost the traction company about $20,000. New car houses and repair shops both for the railway lines and the San Joaquin Power Company will be erected at Sunnyside.

LOS ANGELES, CAL.—The Pacific Electric Railway is to be extended to Covina over the old Rapid Transit Railway right of way as far as Shorb Station, through Savannah, El Monte, and thence to Covina.

LOS ANGELES, CAL.—"We are preparing to furnish the traveling public a shorter, faster line to Pasadena," said H. E. Huntington to a Street Railway Journal representative recently, on his departure for a six weeks' business trip to New York. Mr. Huntington referred to work just begun on the line of the old San Gabriel Valley Rapid Transit Company, which will connect with the present Pasadena Short Line of the Pacific Railway Company east of the Los Angeles River, crossing on Aliso Street, continuing by a private right of way to a point east of Eastlake Park, whence a direct line will be run to connect with the present roadway, now under operation. A large force of men is now at work repairing the old roadbed. It is understood that this new line will provide a direct route not only to Pasadena, but to Corina and other foot-hill towns as well.

LOS ANGELES, CAL.—W. D. Larabee, formerly superintendent of the Los Angeles-Pacific Railroad Company, has interested Los Angeles capitalists in a railway project in Northern Oregon. Articles of incorporation have been filed in Portland for the United Railways Company. Among the incorporators are: W. D. Larabee, M. H. French and J. Whyte Evans, of Los Angeles. The company is capitalized at $5,000,000, and proposes to build a railway from Portland to Peak that can be operated either by steam or electricity. A street railway system also will be installed in Portland.

MILL VALLEY, CAL.—The company which operates the Mount Tomalpais Scenic Railway, connecting at this point with the North Shore Electric lines, is rushing work on a 5-mile branch which will terminate in a virgin redwood forest.

NEVADA CITY, CAL.—A new industrial electric railway has been built by the North Star Company. The line is 2½ miles long and connects every department of the Central and North Star mines. It will carry ore from the Central shaft to the North Star mill, and thence to the cyanide plants. In addition to this it will convey iron, ore or any material to any part of the mine. It will take the place of several teams which have been hauling between the two mines, these teams supplanting a traction engine used several years ago. It is estimated that the new method of transportation will effect a saving to the company of several hundred dollars a month. Twenty-five iron and steel cars are being built to hold and carry the ore.

PETALUMA, CAL.—Surveyors have commenced work on the new electric railway which is to run direct from this city to Santa Rosa, avoiding the loss of time involved in the roundabout route by way of Sebastopol. Surveys have been completed as far as Stoney Point, where the new line will make its first change of course. The work is to be rapidly pushed.

REDDING, CAL.—The Shasta County Board of Trade has been notified of the intention of the Boston syndicate promoted by Alonzo Cloaver to construct an electric railway from Redding to Weaverville and thence to the Pacific Coast. The surveys have already been made. The work is to commence as soon as the road of the same company now being built out of Union, Ore., is well under way. Trinity and Shasta Counties will give moral and financial support to the new road here, which will touch great mining and lumbering regions.

SAN FRANCISCO, CAL.—A plan is on foot to create at Inverness, on Tomalos Bay, a large summer resort like Del Monte, at Monterey, and if the plan is carried out it will involve the construction of an electric railway between Inverness and Point Reyer, the nearest railroad station.

SAN BERNARDINO, CAL.—Shipments of material are arriving for the installation of a modern incline railway which is now being constructed to the summit of the mountain range above Arrowhead, Hot Springs, of this county. This incline is to be about 1700 ft. in length, and will have a grade of 45 per cent. Track laying is being completed as fast as possible. The road will resemble the Mount Lowe Railway, and after it has been used for the transportation of freight needed in building the great Arrowhead dam it will be operated as a scenic passenger line, connecting with the proposed electric railway from San Bernardino to the base of the mountains.

SAN JOSE, CAL.—The San Jose & Santa Clara Railroad Company has been granted a franchise for a broad-gage electric railway on Santa Clara and Tenth Streets for a period of fifty years. The railroad company at present has a franchise over the right of way mentioned, but it has only eighteen years to run. Under the new fifty-year franchise extensive improvements will be made, including the making of the tracks broad gage. The road will be newly equipped and cars will be run on a five-minute schedule. Prior to the granting of the franchise many obstacles were placed in the way by opposing railroad interests. Mandamus proceedings to prevent the granting of the franchise are pending at present before the Supreme Court.

STOCKTON, CAL.—Sealed bids will be received up to 8 p. m., Feb. 19, for a franchise to construct and operate an electric railway upon certain streets here. Newton Rutherford is city clerk.

STOCKTON, CAL.—The Stockton Electric Railway Company will soon begin the work of broad-gaging all of its tracks. City Surveyor Tumelty, who was engaged to run the levels for the new tracks, has finished the work on El Dorado, Main and California Streets. He will begin at once the levels on the line reaching from Main Street to the baths on San Joaquin Street.

VALLEJO, CAL.—Sealed bids will be received up to 10 a. m. Feb. 5, at the office of G. G. Halliday, County Clerk, at Fairfield, for the purchase of franchises to construct and operate an electric road upon certain streets, as applied for by Jas. A. Keys and J. W. Hartzell.

HARTFORD, CONN.—The Consolidated Railway Company is about to commence work on two brick sub-stations to be used in operating the new system of trolley cars to be run on the steam road between Hartford and Rockville. The sub-stations are to be built of brick, and one will be located in Buckland, not far from the passenger station, and the other will be located at West Street in Rockville. The power for running the new line will be supplied by the Hartford Electric Light Company, and when it leaves the power station it will be in the form of an alternating current. The contract for the sub-stations was let to the H. Wales Lines Company Dec. 26. The bonding of the rails on the steam road has been completed from Burnside to Manchester, and the work of setting the poles has begun at Burnside and has been carried on a short distance toward Manchester.

MIDDLETOWN, CONN.—It is said on good authority that the Consolidated Street Railway Company is planning to lay a trolley line for some distance along the river and connect it with the main trolley lines now in use in the city. It will be mostly for the purpose of carrying freight. The plans are said to call for an extension of the tracks along Water Street, from the foot of Washington, to Union Street, and thence to the lines of the South Farms Division. This would pass the freight depot and steamboat wharf and would make things very handy for shippers at the South Farms.

WASHINGTON, D. C.—Workmen have been busily engaged for the past week at the Georgetown station and office building of the Capital Traction Company, converting a portion of the second floor of the structure, which has heretofore been used for storage purposes, into an office apartment for the accommodation of the officials of the Great Falls & Old Dominion Railway Company. In addition to this, it is also known that the Great Falls Company is to extend the underground portion of its road to its car house, several hundred yards from the Government's reservation at Roslyn, instead of terminating it at the Virginia end of the Aqueduct bridge, as it is at present provided for. This will necessitate the reconstruction of that portion of the road which extends from the Virginia end of the Aqueduct bridge to the car house, as at present it is built for overhead trolley. The Great Falls & Old Dominion line is now practically complete. No date has been set for the opening of the road.

CHICAGO, ILL.—Amendments to the Mayor's $75,000,000 Mueller ordinance, which was passed by the City Council Jan. 18, are being prepared by attorneys. "There will be some amendments," said the Mayor, "but the method of their introduction will be a question for the attorneys for the city's interests to decide. I am not yet prepared to say anything about the selection of men for trustees under the ordinance passed by the City Council." Before a meeting of the Real Estate Board, held recently, Frank G. Hayne said he did not believe the people would authorize the issue of $75,000,000 worth of Mueller certificates at the polls, and if they did so, he thought purchasers would be difficult to find.

CRAWFORDSVILLE, IND.—The Crawfordsville & Northwestern Traction Company has filed articles of incorporation with the Secretary of State. The capital stock is $100,000. The proposed line is to start at Crawfordsville and pass through Wesley, Waynetown, New Richmond, Wingate, Atteca, Hillsboro, Melott, Aylesworth, Stone Bluff, Newton, Williamsport, Kramer, Carbondale, Judyville and Pener. Spencer J. Hunt, A. L. Mason and J. F. McFarland are the incorporators. J. W. Farrell, in charge of an engineering corps, has begun the survey of the company's line between Crawfordsville and Hoofston, Ill., by way of Attica and numerous towns along the line. Spencer J. Hunt represents the capitalist building the road, and is arranging to let the contract as soon as the survey is completed.