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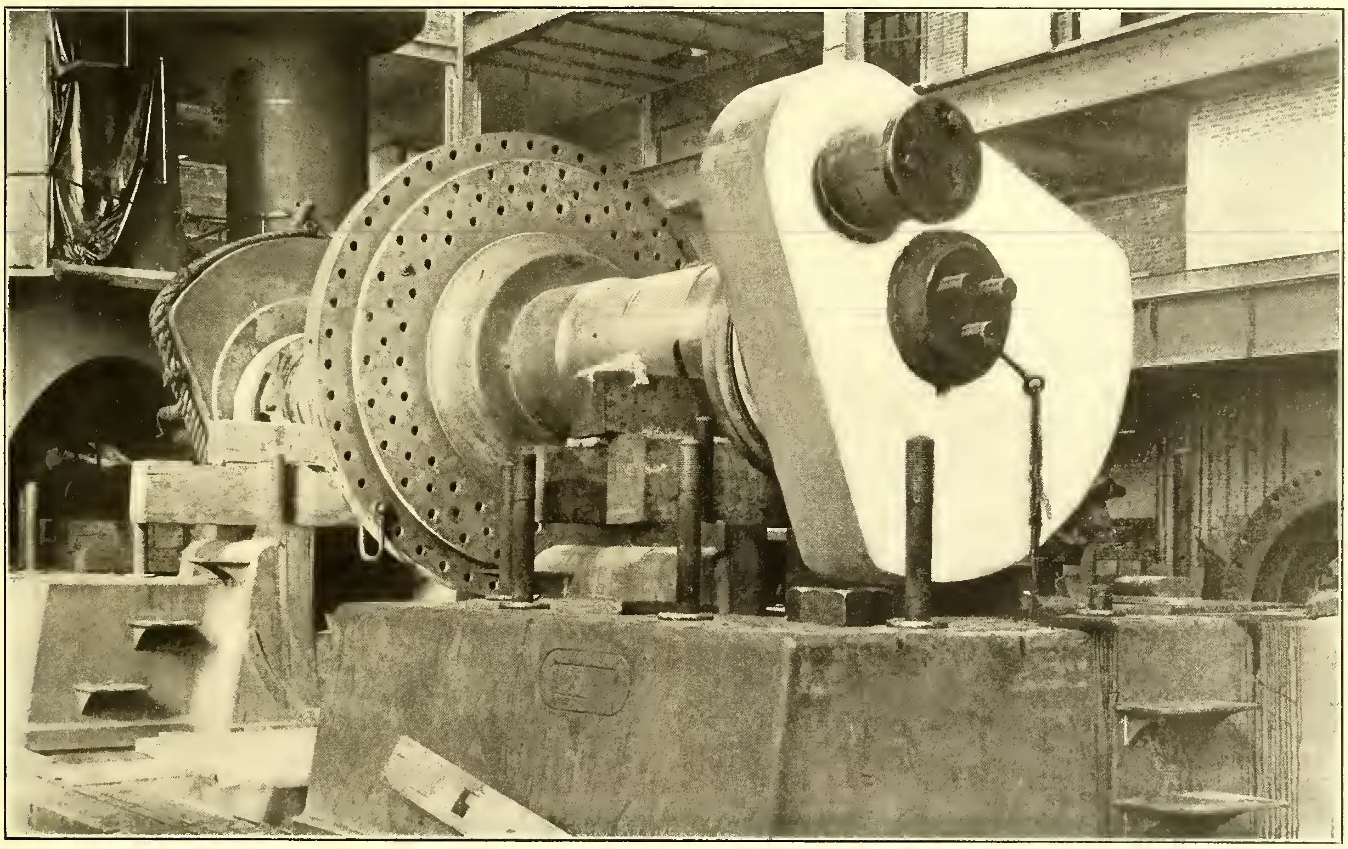
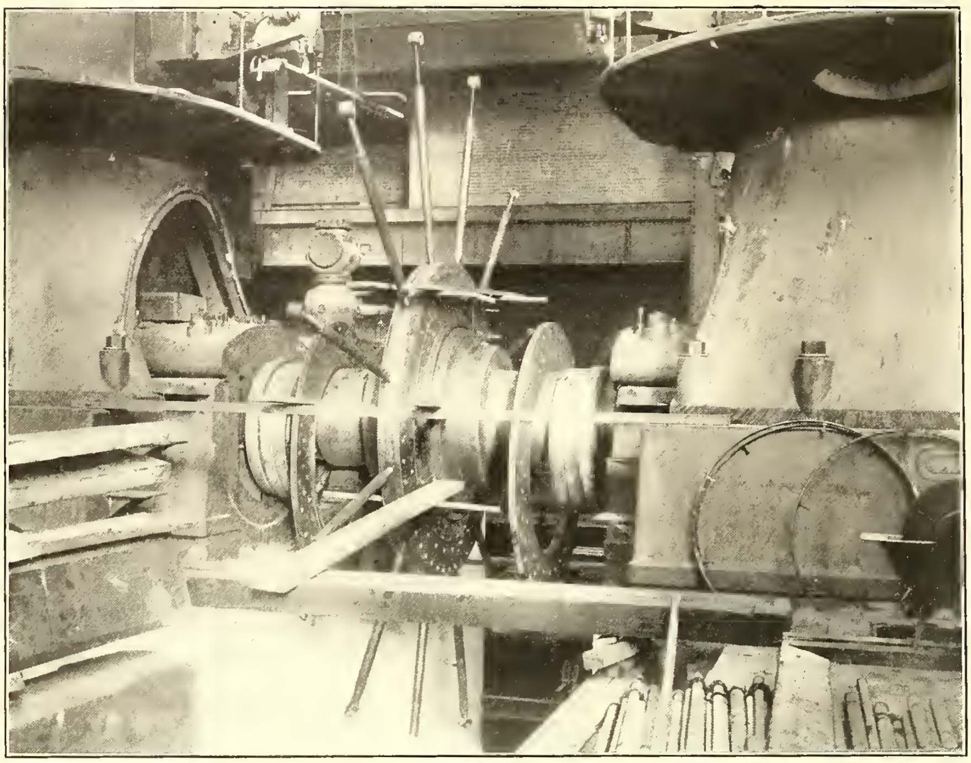
NEW POWER STATION OF THE MANHATTAN RAILWAY COMPANY

The Street Railway Journal for January, 1901, contained a complete description of the electrical system to be installed on the Manhattan (elevated) Railway, in New York. The three engineers of the company, George H. Pegram, W. E. Baker and L. B. Stillwell, furnished exhaustive articles on the various departments of the equipment which came under their immediate supervision in design, and these articles so thoroughly covered the subject that but little can be said further about the work as it has been carried out, the original plans having, with very few exceptions, been used in their entirety.



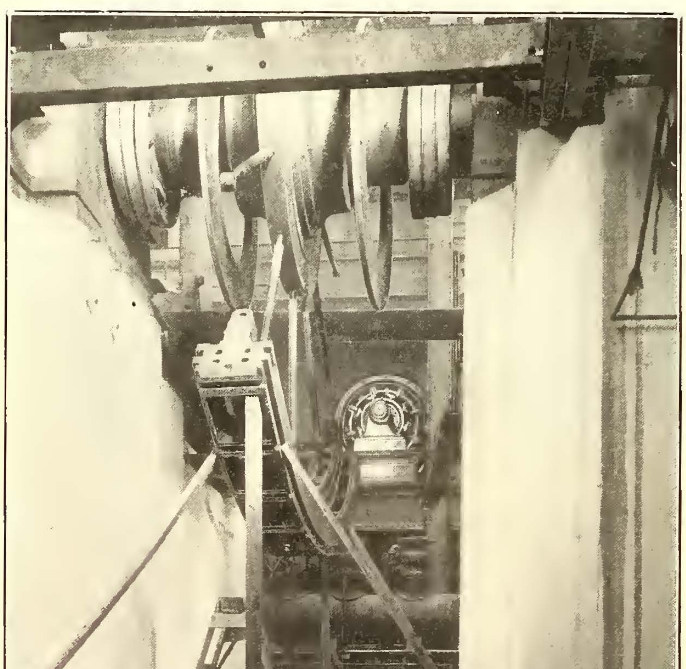
HOLLOW FORGED STEEL SHAFT WITH HUB AND CRANKS

Looked at, therefore, as a completed power station, the subject has been most thoroughly treated in these pages, but the construction of the immense engines and generators involve many novel details which are of great interest to the engineering profession, owing to the ingenious methods which are used in rapidly and satisfactorily erecting the machines. The illustrations accompanying this article show the various steps in the assembling of one of these units, which consists of a Reynolds engine, built by the Allis-Chalmers Company, direct coupled to a revolving-field Westinghouse generator. Notwithstanding the great weight of the castings and the peculiar design of the engines which connected four piston-rods, two high pressure and two low pressure, on two cranks placed at an angle of 135 degs., and thus obtained eight impulses upon the shaft during one revolution, the layout of the engine foundations and the placing thereon of the engine-bed castings and the high-pressure cylinders was performed in the usual manner. The center lines of the horizontal cylinders and shaft were determined by gage lines made of twine squared up by diagonal measurements with a steel tape under a given tension obtained by a spring balance, and the shaft was dropped into position in its bearings from the overhead crane with as great ease as is found in engines of smaller construction. Before placing the shaft in its bearings, the generator hub and cranks were forced thereon by a portable hydraulic press, which had a capacity of 500 tons pressure. About 350 tons pressure was used for the hub. The bed-plate of the engine is held to the foundation by a type of stay-bolt which is threaded at each end and reaches from the bottom of the foundation to the top, a distance of some 23 feet. The lower end of the bolt is received by a large nut in a cast-iron receptacle buried in the concrete foundation, and during the building of the power station, after the foundations had been constructed, the ends of the tubes which were to receive the bolts were closed by the insertion of a wooden plug. This prevented any foreign material from falling into the end of the tube and interfering with the engaging of the lower thread of the bolt with the thread in the foundation nut. The upper end of the bolt, after passing through the engine bed, was supplied with a washer and hexagonal nut in the usual manner.



HUB WITH TEMPORARY SPOKES FOR RIM

The low-pressure cylinders are not truly vertical, but their center lines slope inward toward the top. The peculiar construction of the double engine, with the immense weight of 370,000 lbs. in the combined fly-wheel and generator field between the two bearings and the cranks just outside, gives to the shaft an appreciable deflection at the center, which has been carefully calculated, and for which allowance has been made. This forcing down of the central portion makes fulcrums of the journal boxes and gives an upward direction to the ends of the shaft, causing the cranks to revolve in a plane slightly out of perpendicular with the horizontal plane upon which the high-pressure cylinders are set up. If the impulses from the low-pressure pistons were received in a true vertical direction, therefore, a large amount of undue wear would result at the crankpin. The accompanying sketch shows the amounts that the central lines of the engine were displaced from the vertical. Assuming the height of the engines above shaft center to be 30 ft., this makes the center lines of cylinders 7-32 in. closer together at the top than at the shaft. In other words, if the low-pressure cylinders were placed absolutely vertical, each would actually be out of line 7-64 in. To obtain this inclination of the cylinders a 30-in. spirit level was used in erecting the cast-iron uprights upon which they rest, this level having a graduated glass upon which the necessary deflection was accurately determined. As shown by the sketch, this deflection, as calculated from the weight of the generator and rigidity of the shaft, was .0095 in. in 30 ins., the length of the level. This deflection of the



ONE SECTION OF RIM ON TEMPORARY SPOKES

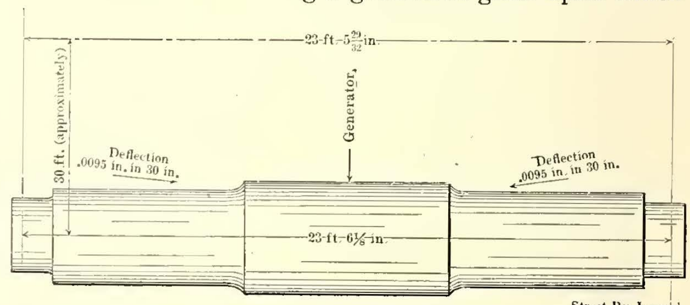
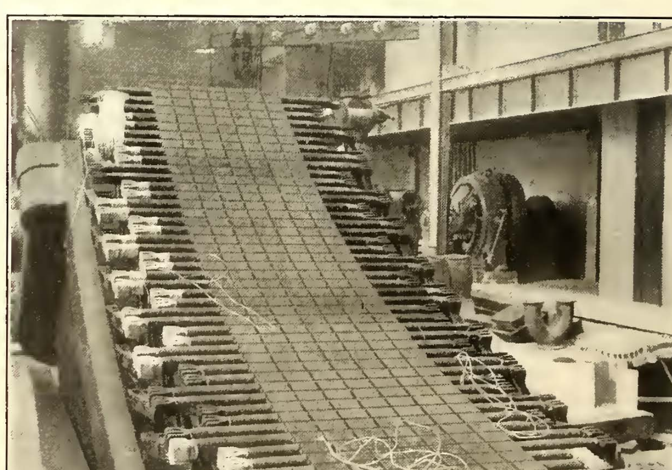
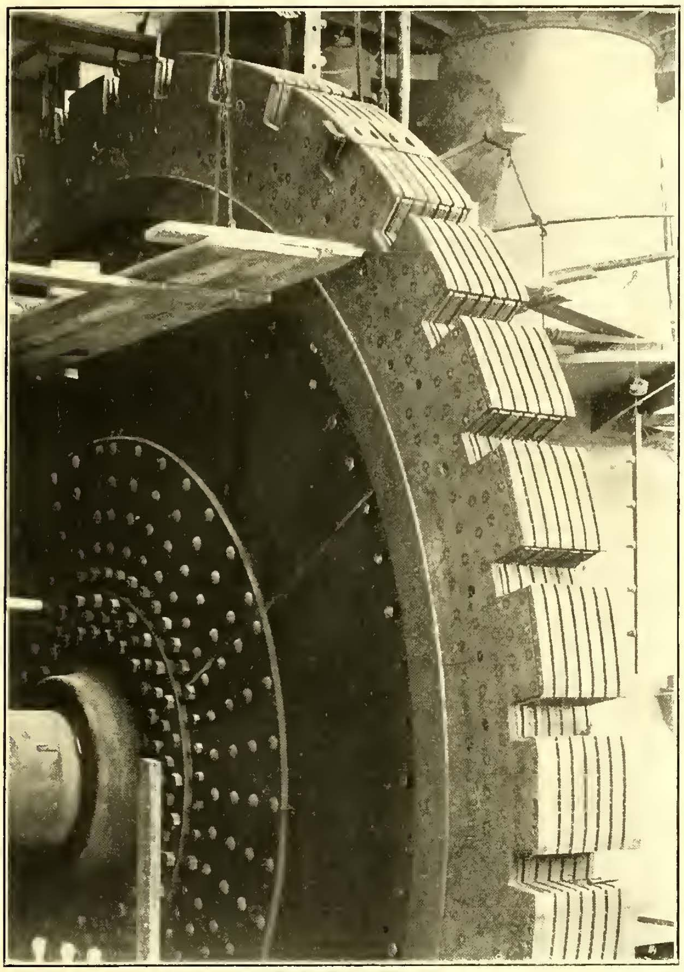


DIAGRAM SHOWING DEFLECTION OF SHAFT

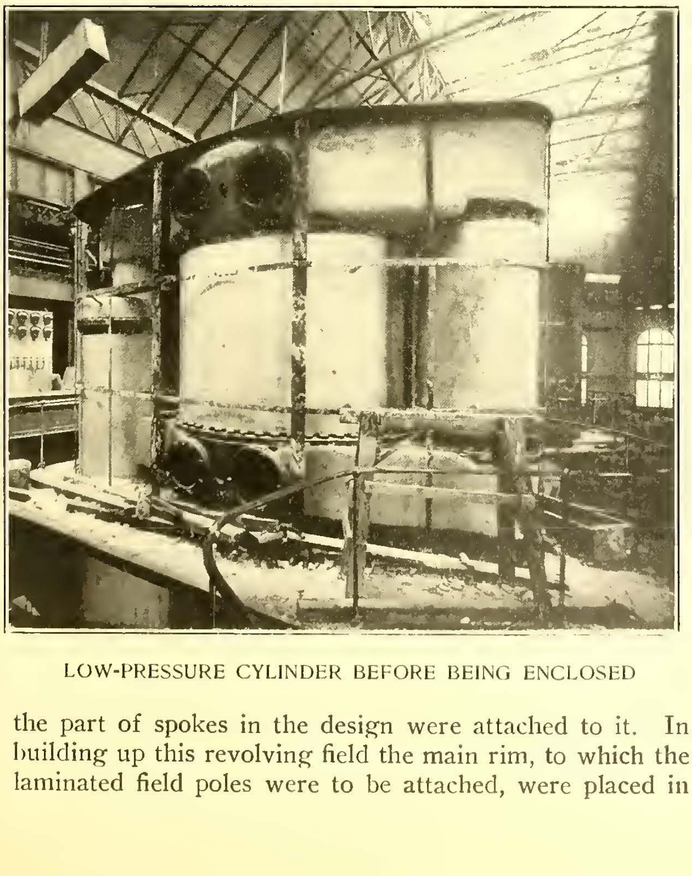


ARMATURE IN COURSE OF CONSTRUCTION AT THE POWER HOUSE shaft has, of course, no effect on the horizontal cylinders, as the cylindrical cross-head ways adapt the connecting rod to the inclined rotation of the crank.



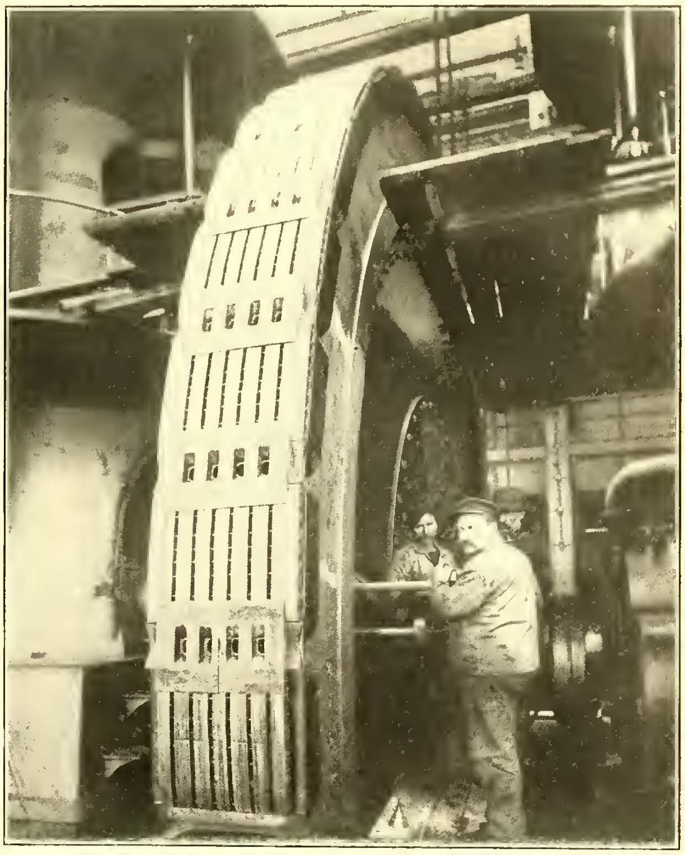
POLE PIECES BEFORE FIELD COILS WERE IN POSITION

The hub of the generator's field magnet, which is made of cast steel, was placed in position on the shaft before any of the peripheral castings or web plates which took



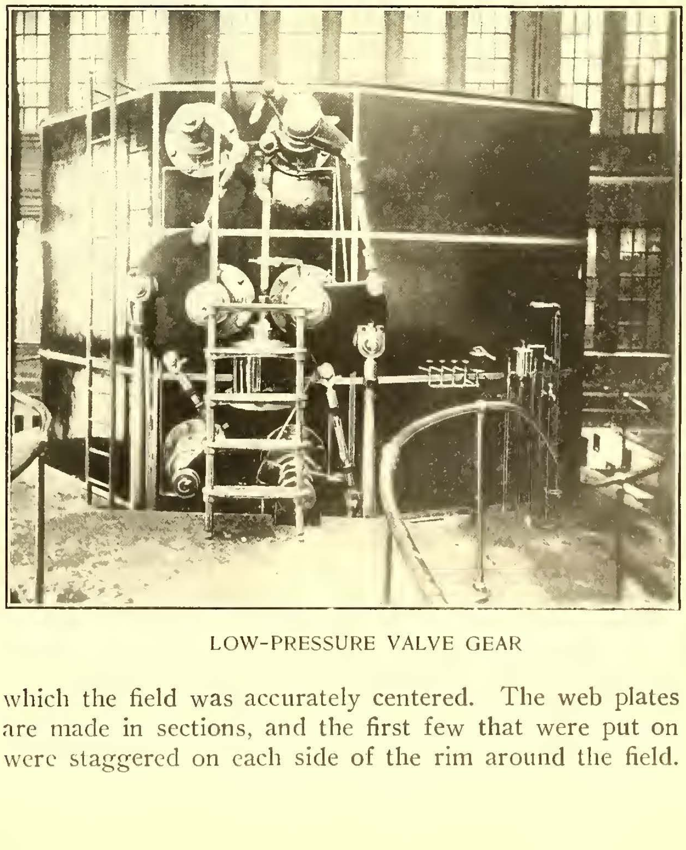
LOW-PRESSURE CYLINDER BEFORE BEING ENCLOSED

the part of spokes in the design were attached to it. In building up this revolving field the main rim, to which the laminated field poles were to be attached, were placed in position and held by temporary spokes before the side webs were put on. One of the illustrations shows the lower section of this cast-iron rim on the end of the spokes. There are four of these sections, and they were built up around the spokes with the wheel in a stationary position and keyed together. After the rim had been bolted and



THE FIELD. REAMING OUT HOLES FOR FINAL BOLTS

keyed together it was trued up on the inside by a gage rod placed between the hub and the rim. The temporary spokes were provided with turnbuckles, consisting of long nuts with fine right and left-hand screw threads, by means of

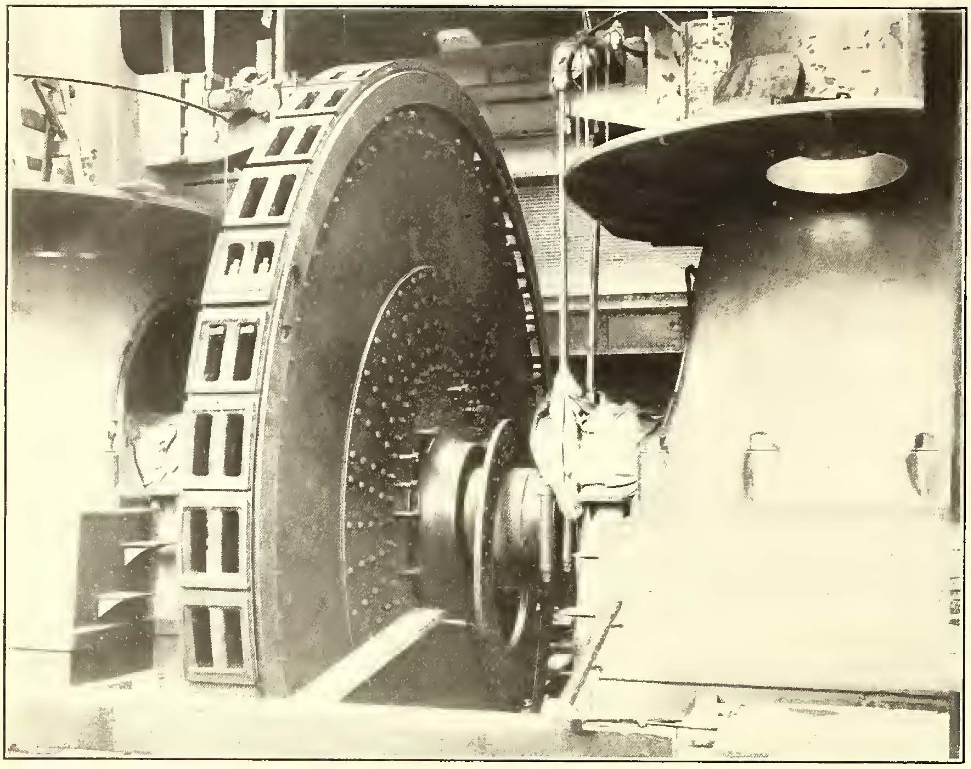


LOW-PRESSURE VALVE GEAR

which the field was accurately centered. The web plates are made in sections, and the first few that were put on were staggered on each side of the rim around the field.

These held the rim in position while the temporary spokes were removed.

At the center of the web strengthening plates were riveted to the sections before they were erected. The remaining connections in the construction of the wheel are made with heavy bolts, which pass through from one side of the wheel to the other in holes reamed out after the plates are in position. At the sides of the hub, outside of the web plates, are placed two large rings, which further aid in strengthening the joint of the web plates with the hub. In the view showing the first section of the rim being placed in position, these rings are seen resting on the shaft at the side of the hub. The hub contains ridges which engage in corresponding recesses in the inside parts of the web, to prevent the centrifugal force placing too great a strain upon the bolts, and giving further rigidity to the fly-wheel construction. The distribution of weight in this fly-wheel was necessarily very carefully determined, as in order to get the true turning movement the mechanical and electrical strains had to be calculated with great nicety. The eight impulses received by the crank from the four pistons during one revolution of the field is an innovation in steam engine design, and the doing away of auxiliary fly-wheels in combined units of this size is a great step in advance in the art of stationary engineering. As the entire station, consisting of eight generators of 5000 kw nominal rating each, is expected to run in parrallel, and the frequency is 25 cycles per second, it is absolutely necessary that the strictest conformity to the original compromise between the engine and generator builders regarding the allowable variation in angular velocity should be secured.

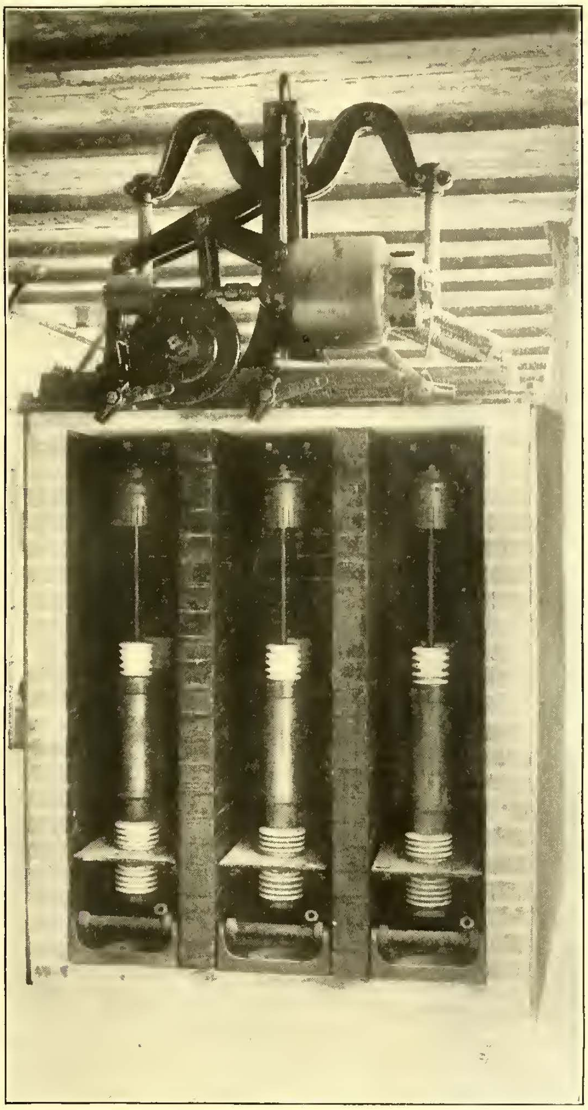


FIELD BEFORE LAMINATED POLE PIECES WERE ATTACHED

The generators, which were supplied by the Westinghouse Electric and Manufacturing Company, are the largest that have ever been built, and with one exception they are larger than ever before attempted. Some years ago Ferranti projected some machines, which were possibly of greater capacity, but these were never built. The voltage which is generated is 11,000 volts at the machine itself, which is much higher than has ever before been attempted in the larger sizes of apparatus. The armature "winding" was placed in the slots after the frames had arrived at the power station, and the process is one of considerable interest. The winding consists of three bars per slot, with heavy insulation between and surrounding the bundle of rectangular conductors and was insulated before leaving the factory. These bundles of conductors just fit the slots between the armature teeth. Before being forced into the slots the exterior is rubbed with paraffin in order to further facilitate the insertion of the conductors. The interior of the slot is lined with Express paper, a tube of which is slipped in before inserting the bundle of conductors, more for mechanical reasons than as an insulation. The insulation which surrounds each individual bar is a wrapping of mica and fillerboard. The three bars are then placed together, and the whole sur-

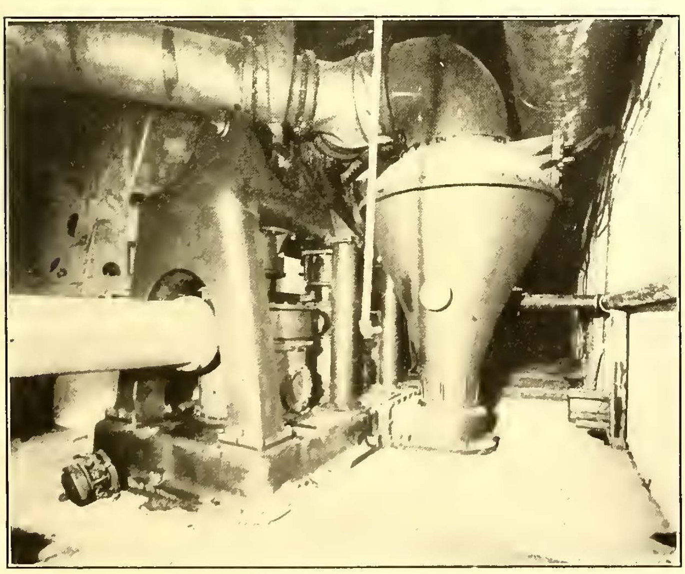
BOILER ROOM—SECOND FLOOR

INTERIOR VIEW OF THE SEVENTY-FOURTH STREET STATION OF THE MANHATTAN RAILWAY CO. OF NEW YORK CITY, SHOWING EIGHT 8,000-H. P. GENERATING UNITS rounded by an exterior coating of alternate layers of mica and fillerboard. Between bars the insulation was tested



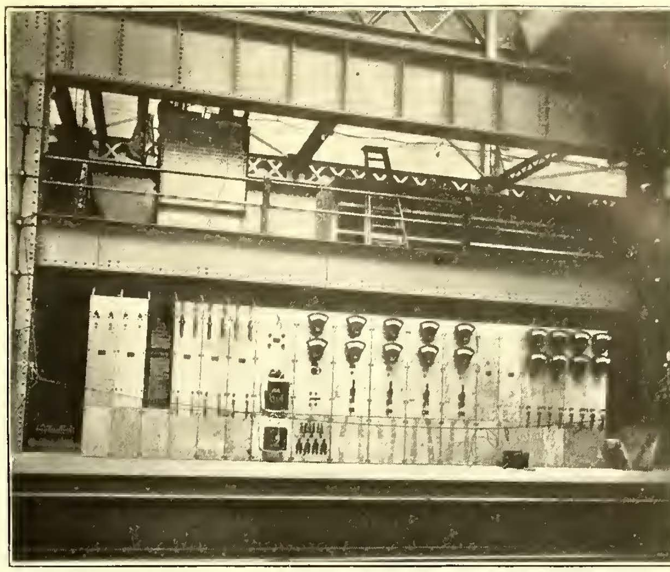
HIGH-TENSION SWITCH WITH DOORS REMOVED

by a high voltage test of 3000 volts, and from the winding to the ground 25,000 volts were kept on for thirty minutes. Only bars belonging to one phase are placed together in



ONE OF THE 8000-HP CONDENSERS

the slots. The machines have been tested by water rheostats, which are placed in the rear of the power station, but not to



EXCITER SWITCHBOARD IN GALLERY

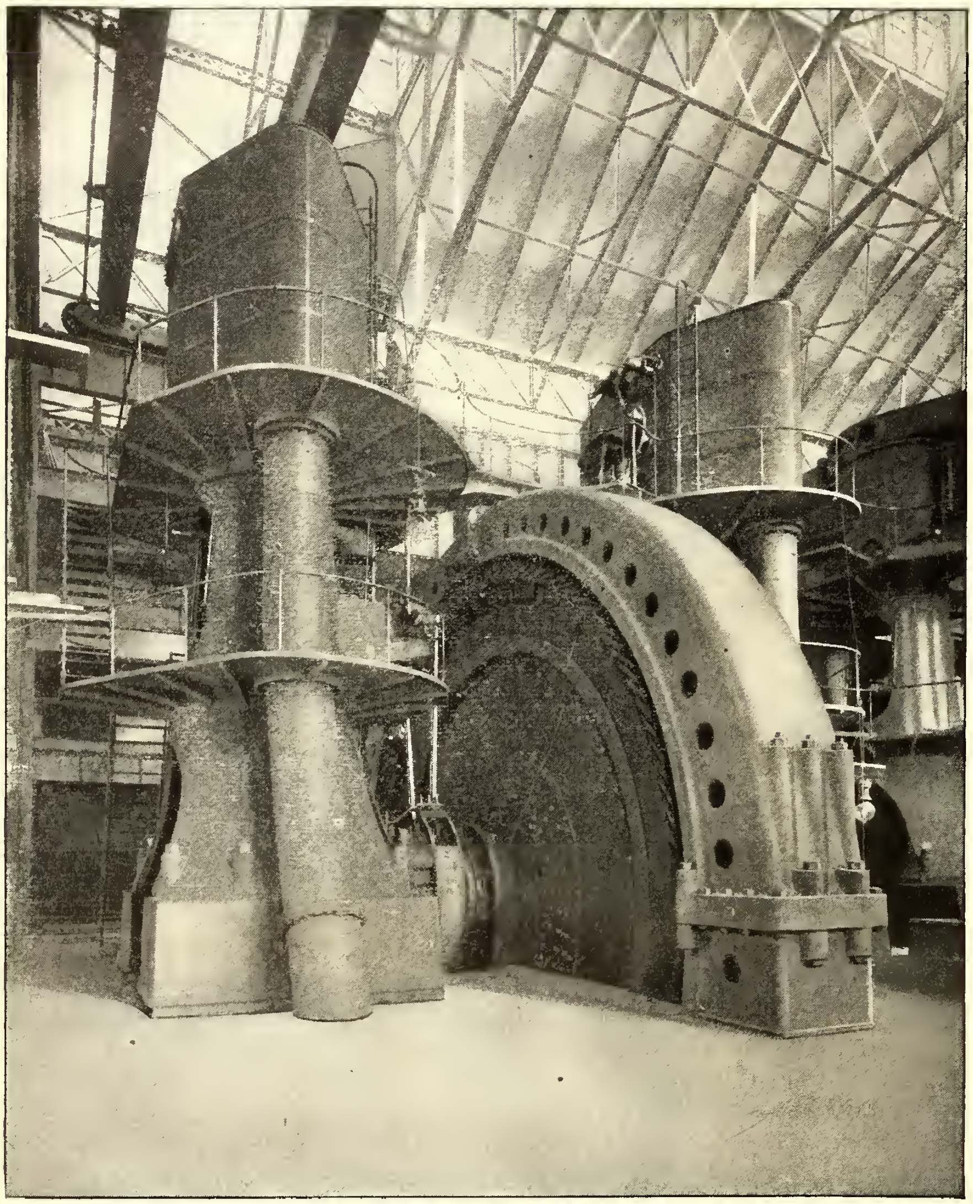
ENGINE PARTS BEFORE ERECTION

VIEW OF THE HEADERS

their full rating. These rheostats are connected to a bank of six transformers, which reduces the voltage to about

2000 volts. The rheostats were the ordinary vat type, the movable plates being operated by ropes. There are three rheostats—one in each phase of the 2000-volt secondary circuit.

In the 22½-in. face of the armature there are six ⅝-in. air ducts, which are provided for ventilating the laminations. These air ducts are made by bronze castings built up with the laminations, and correspond to similar air ducts placed in the field poles. The draft produced by this combination of air ducts in the stationary armature and revolving field is expected to give sufficient ventilation to the generator to enable it to be considerably overloaded, but as yet no overload tests have been made.



COMPLETED ENGINE AND GENERATOR

The care with which the original design was laid out is shown by the accuracy with which the parts of both engine and generator have been put together at the station. The engines are placed so that there is just sufficient room between each for the removal of the long Corliss valves in the high-pressure cylinders, there being but about 1 in. clearance when the valve is being taken out. The cylinder of engine No. 8, the first engine to be erected, which stands at the west end of the power house, is so close to the offices in the gallery that a door has had to be cut in the office front in order to allow of the removal of the low-pressure valves. The valve gear, except for its massiveness, does not differ materially from standard Allis-Chalmers practice. One of the views shows the manner in which the receiver and exhaust pipe of the low-pressure cylinders are placed in position within the diamond-shaped covering.

The shafts for the engines were supplied by the Bethlehem Steel Company, South Bethlehem, Pa. They were made of medium carbon open-hearth steel, the ingots being cast under fluid compression. They were hydraulically forged on a mandrel under a 15,000-ton press, and were subsequently thoroughly annealed. The dimensions are 37 ins. diameter in the center, 34 ins. at the bearings, and 30 ins. in the crank-fit, the axial hole being 16 ins. diameter. These shafts weigh, on an average, 63,000 lbs. each. The total central load, including magnetic pull, was estimated to be about 440,000 lbs., or a pressure of 266 lbs. per square inch of projected area on bearings when engine is developing 12,000 hp. The pressure per square inch of projected area due to dead weights is 127 lbs. per square inch. The surface velocity when engine is running at 75 revolutions is 667 ft. per minute. The maximum fibre stress due to the combined forces of bending and torsion is 4200 lbs. per square inch. A solid shaft of the same strength would have been 36⅜ ins. diameter, and have weighed 84,000 lbs., or 21,000 lbs. more than the present shaft. Comparing this shaft with a shaft of the same outside dimensions made of fluid-compressed, oil-tempered, hydraulically forged nickel-steel for the Boston Elevated road, with an axial hole 17½ ins. diameter, the latter was intended to resist a fibre stress of 9000 lbs. per square inch of combined bending and twisting forces, and the journals had a pressure per square inch of projected area for weights and pressure of 300 lbs.

The boiler plant consists of sixty four Babcock & Wilcox horizontal water-tubular boilers arranged in batteries of two, four batteries being connected to each generating unit. The boilers are equipped with Roney stokers, supplied by Westinghouse, Church, Kerr & Company, and economizers made by the Green Fuel Economizer Company, Matteawan, N. Y., are placed in the flues back of the boilers. The feed-water is heated by these economizers alone, the electrical operation of the auxiliaries preventing the use of exhaust steam feed-water heaters.

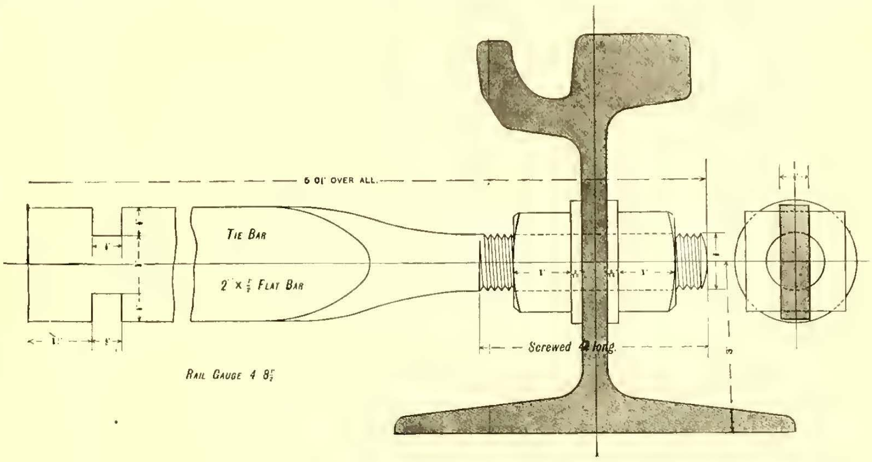
The steam piping, which was contracted for by the McLeod Company, of New York and Chicago, is very simple. One of its features is having a separate header for each engine. These headers supply both high-pressure cylinders through separate steam pipes, and are provided with a number of valves, as shown in the illustration.

The switchboards, switches, etc., which were all furnished by the General Electric Company, of Schenectady, N. Y., have been fully described in former articles. Views of the exciter board and one of the high-tension switches are shown herewith.

The Salford Corporation Tramways

Particulars were published in the last monthly issue of this paper of two recently completed tramways in England—those at Brighton and Portsmouth. Electric tramway construction in that country is rapidly increasing, and this month it is possible to present an account of another line opened for service recently, that at Salford, near Manchester. This line has been owned by the city since 1874, but up to within a year or so ago was operated under a twenty-one-year lease by the Manchester Carriage & Tramways Company. At the expiration of that lease the property was taken over by the city, and construction was commenced under the supervision of Ernest Hatton, general manager and engineer. When completed, the system will comprise 35½ miles of single track, to which should be added 12 miles of track in outside boroughs, which have been leased to the corporation.

The accompanying engravings show the section of rail adopted. Each rail weighs 103 lbs. per yard, and it is laid in 60-ft. lengths, though a percentage, not exceeding 10 per cent, was accepted in lengths of 30 ft. or 40 ft. The angle-plates are 27 ins. long and the sole-plates are also 27 ins. long, being 8 ins. wide and ¾ in. thick. The tie-bars, bolts and nuts are also of steel, the tie-bars being 2 ins. by ½ in. in section.



SECTION OF RAIL AT TIE-ROD

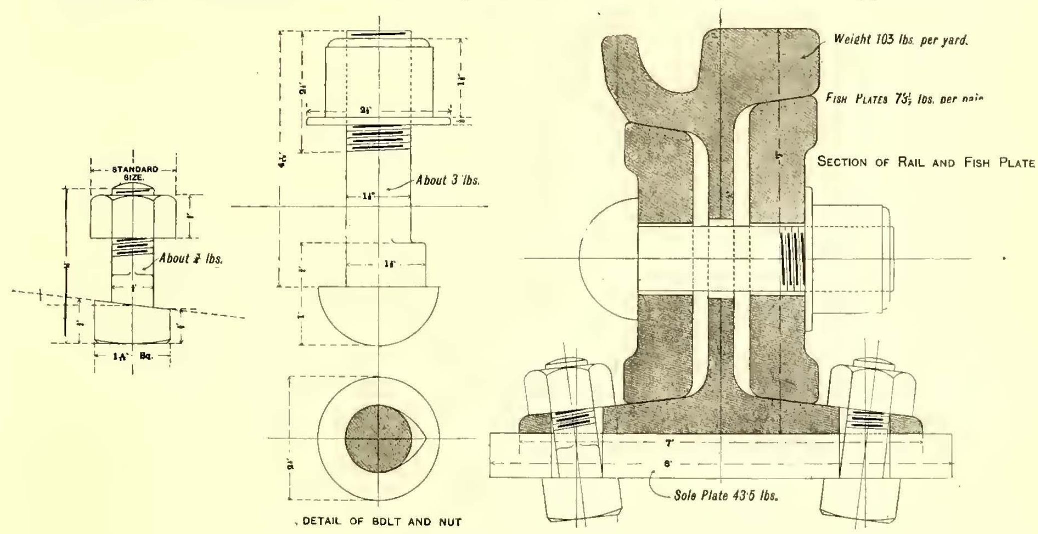
The new cars, which weigh about 7 tons, are of the double-decked pattern, and are capable of carrying fifty-six passengers—twenty-two inside and thirty-four outside. They are painted in cream and maroon, and each car bears the borough arms. Three large windows are fixed on each side of the car, and immediately above are six smaller panes of glass. The cars are all mounted on Brill trucks, and are equipped with the Bellamy reversed staircase. Westinghouse No. 46 motors are used with No. 90 controllers, which is designed for electric braking by utilizing the motors as generators.

The central car house is a large and spacious building, standing on land bought by the corporation for £15,000, and costing, when complete, about £50,000, and accommodates 180 cars. Attached to the main building and forming part of it are the workshops, comprising a paint shop, fitting shop, repair shop, a smithy, and storekeeper's offices. One of the chief engineering features of the house is the provision of ready means for removing disabled cars from any portion of the main building into the various workshops. This will be done by means of a transfer table, electrically driven, along a shallow pit, which will considerably facilitate the internal working arrangements of the service.

While the above work was progressing the Corporation had also been making provision for a new generating station (the old station being considered altogether too small), which would provide for the tramways and lighting and electric power. This new power house has been erected at Strawberry Hill, Pendleton, Messrs. Lacey, Clirehugh and Sillar acting as consulting electrical engineers. The building is situated at the Bolton and Bury Canal, where the Corporation had acquired about 5 acres of land.

The boiler house is 221 ft. long and 57 ft. wide, and the whole of its sixteen boilers are in position. They are fired by means of mechanical stokers, the coal being carried by canal and lifted into these by means of cranes. A commodious economiser room is also provided. The engine house is a lofty and well-lighted structure, 221 ft. long and 44 ft. wide, and is equipped with a traveling crane capable of lifting 30 tons. Both of the chimneys, which are 200 ft. high, are completed.

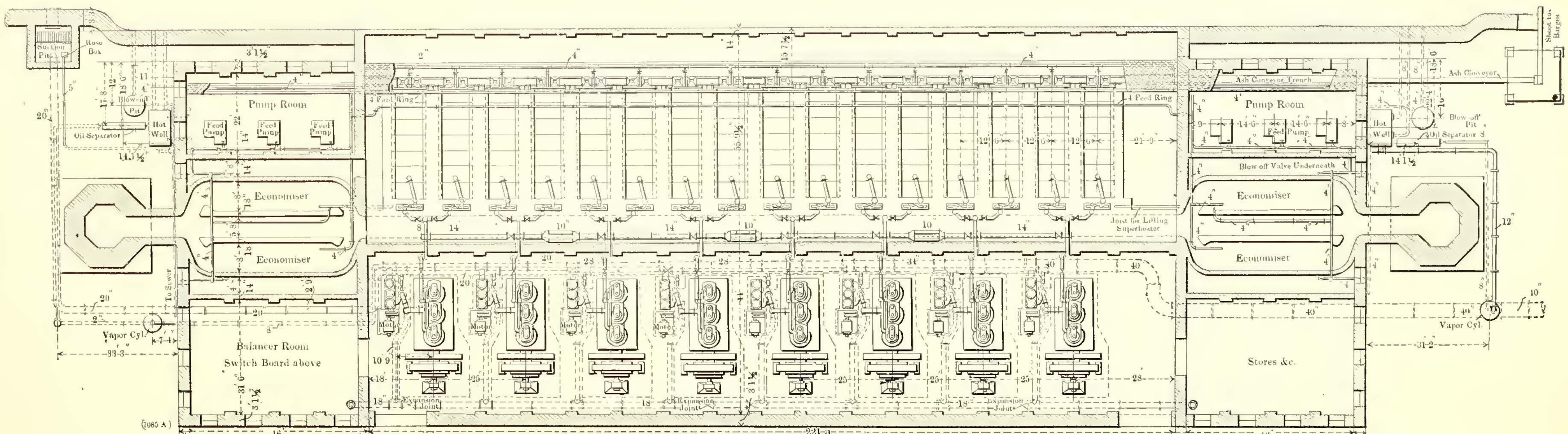
After careful consideration, the engineers came to the conclusion that the area could be most economically served by direct current at a pressure of 550 volts to the tramways, at 440 volts to power users, and at 440 or 220 volts for lighting purposes.



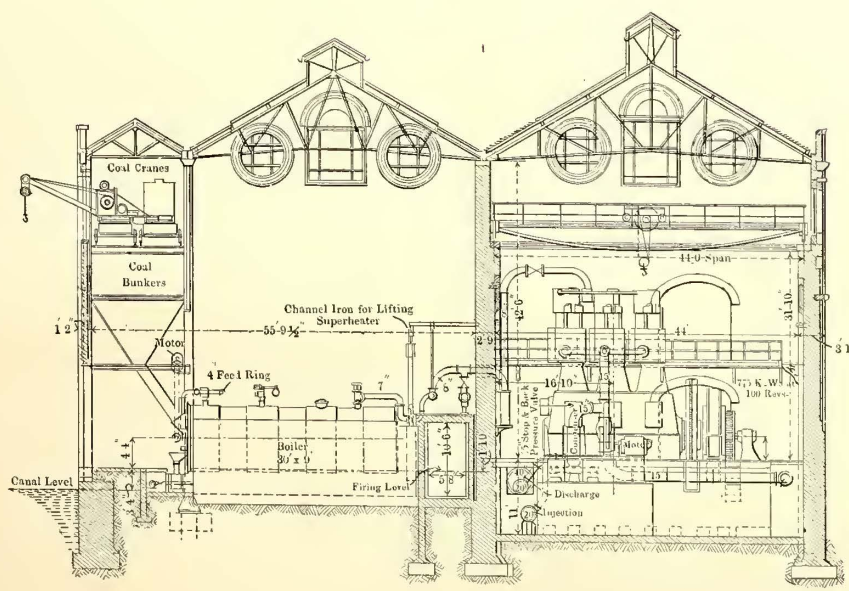
SECTION OF RAIL AT JOINT

It will be of interest in the future to note the actual cost of current per car mile in both Salford and Manchester. The latter city, which adjoins Salford and has running powers over certain of its lines, has adopted high-tension polyphase transmission to converter stations. It is somewhat curious to note that at as recent a date as February, 1899, the Manchester Corporation proposed to run its tramways at a pressure of 400 volts delivered to the car.

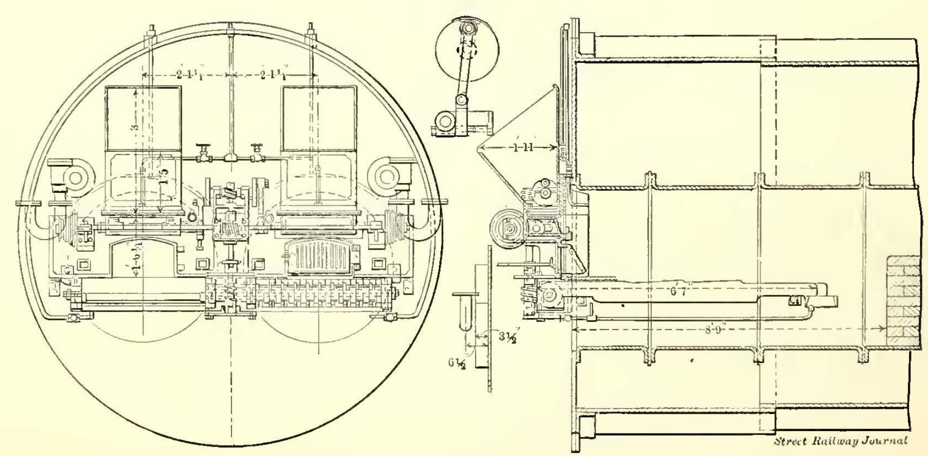
The method of supplying coal to the bunkers may be seen from one of the engravings, but it might be pointed



Plan of Power Station



Section of Power Station



Front Elevation and Sections of Mechanical Stokers

PLAN AND SECTIONS OF POWER STATION OF SALFORD CORPORATION TRAMWAYS out that in certain parts of Lancashire, of which Salford is one, coal is delivered in boxes, each carrying about 2 tons. These boxes fit into barges, and are lifted by a crane. They are fitted with collapsible bottoms, thus enabling the coal to be tipped direct into the bunkers. Shoots connect the hopper on each mechanical stoker direct with the bunkers, and each shoot is fitted with a recording apparatus for measuring the coal delivered into each hopper. The storage capacity of the bunkers over the boilers is about 1600 tons.

The arrangement of steam pipes connects every two boilers to an engine and a by-pass main is fixed which enables, if necessary, any boiler to supply any engine. This also reduces the radiating surface to a minimum.

Special attention has been given in designing the station to reducing the labor as far as possible. The coal is never touched by hand from the time it leaves the colliery screens. The clinker and ashes are conveyed by an ash conveyor to the far end of the building and automatically tipped into either a barge or cart as may be desired. The sixteen boilers, capable of evaporating 200,000 lbs. of water per hour, can be operated by two men, and the eight steam dynamos, capable of indicating 10,000 hp, even if running simultaneously, would only require four men per shift.

The engines, of which there are eight, are constructed to give 1250 ihp each as a normal load, but to be capable of withstanding an overload of 25 per cent. The engines run at a speed of 100 r. p. m., and with a steam pressure of 140 lbs., and, when exhausting into a condenser, having a 26 in. vacuum. They are of the three-crank vertical tandem type, the high-pressure cylinders carried on the top of the low-pressure cylinders on polished steel pillars acting as distance pieces. The distance between the bottom cover of the high-pressure cylinders and the top covers of the low-pressure cylinders is sufficient that the latter may be raised in order to renew the piston rings in the low-pressure cylinder when required. Each low-pressure cylinder is carried on the top of a cast-iron distance piece containing the wiper gland. These distance pieces also contain the bored guides for the cross-head slippers, and are securely bolted to the top of the engine frame. The frame is strongly ribbed and provided with hinged doors, both at the front and at the back of the engine, to give easy access to the working parts of the engine. Each frame weighs about 14 tons.

The base-plate of the engine is of very massive design and contains the four bearings. The outer bearing next to the fly-wheel is 14 ins. diameter by 2 ft. 8 ins. long; the other three bearings are 13 ins. diameter. The bearings are of gun metal, lined with Dewrance's white metal. The crankshaft is of the built-up type, the crankpins are 13 ins. diameter, and a 4-in. diameter hole is bored right through the shaft and also through the crankpins. The end of these holes are plugged up, and the holes act as the reservoir and conductor of the oil supply to the main bearings and crankpins. The eccentric clips are of cast iron, working on cast-iron sheaves.

The whole of the working part of the engines work under forced lubrication, the oil being forced under pressure into each bearing by means of two simple valveless pumps driven by an eccentric on the engine shaft. Each pump is fitted with a filter through which the oil is pumped and which insures clean oil being supplied to the bearings. A pressure gage is fitted outside the frame which shows the pressure of the oil on the bearings.

The governor is of the high-speed centrifugal type, and is contained in a hood carried on the engine frame and close to the starting valve. The governor is under forced lubrication throughout, and runs at a speed of 400 r. p. m. The governor gear is driven by a chain, and a spray of oil

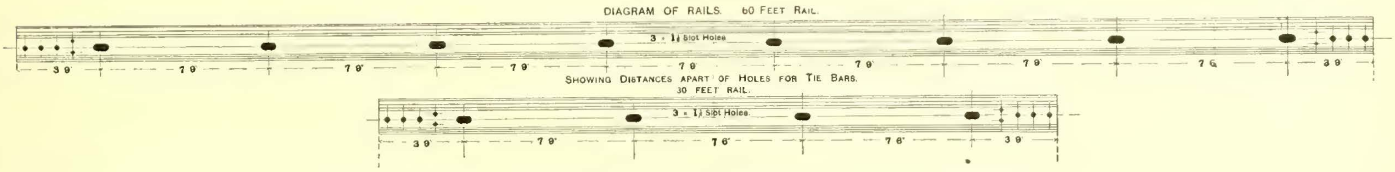
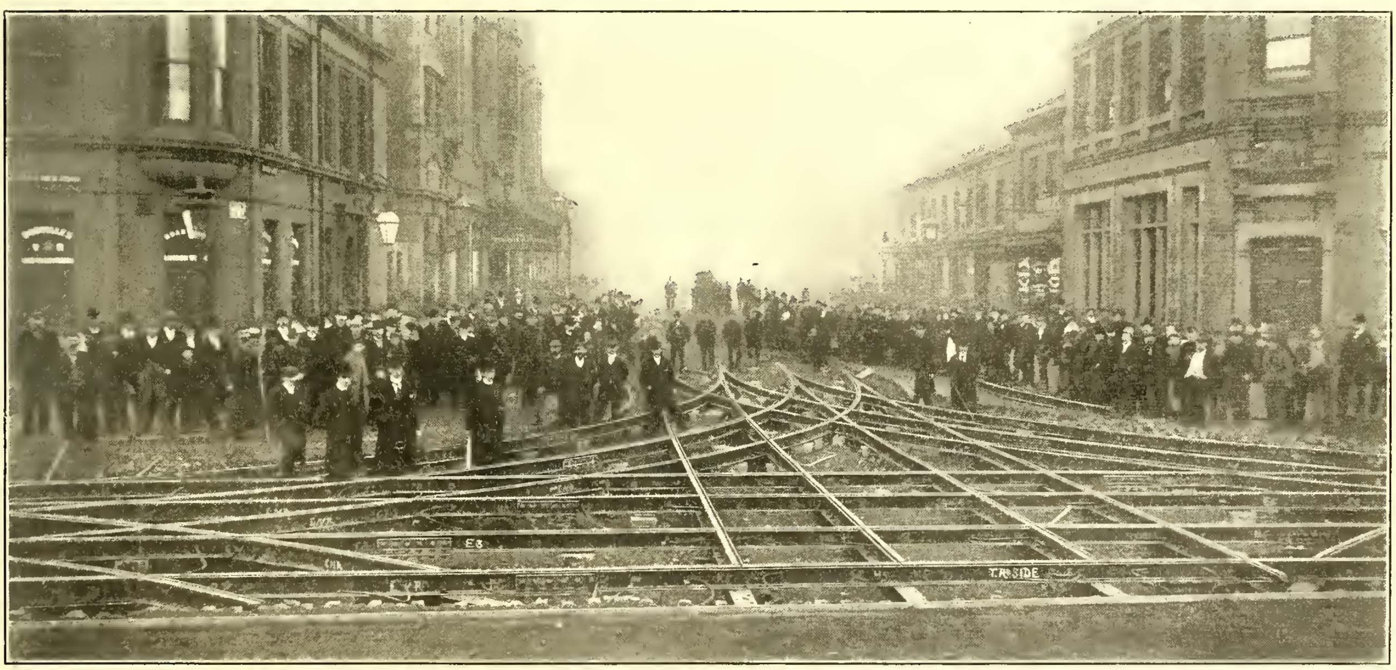


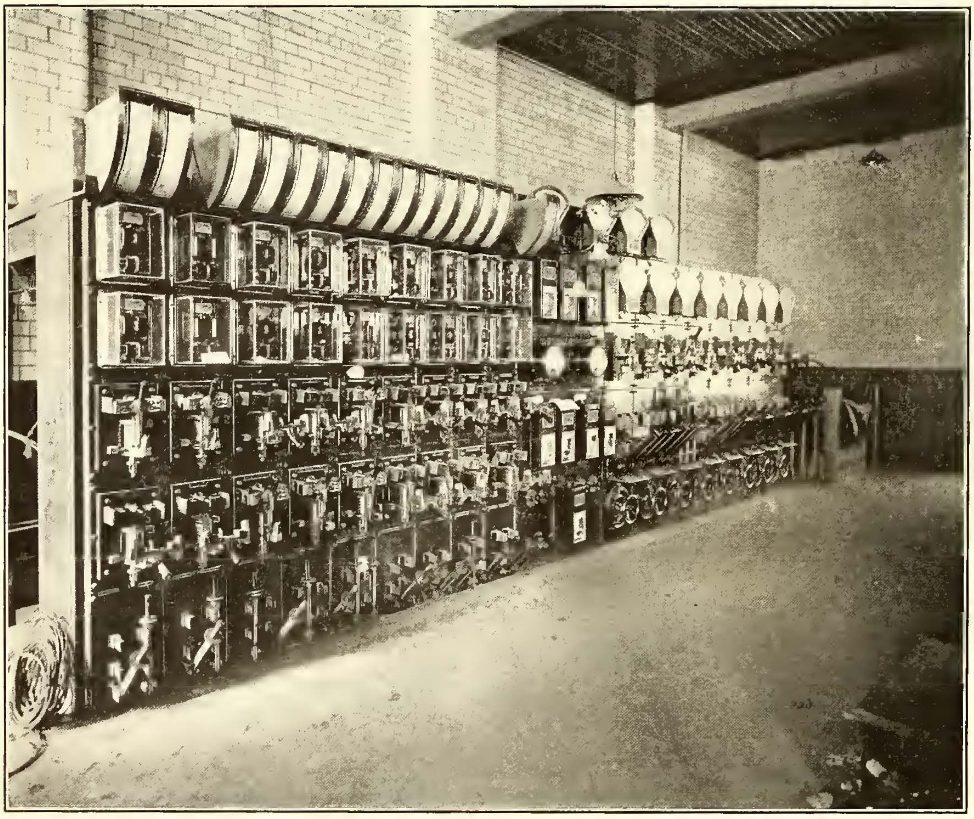
DIAGRAM SHOWING SPACING OF BOLT AND TIE ROD HOLES IN RAILS


DOUBLE TRACK CROSS OVER AND CURVES AT CORNER OF REGENT ROAD, NEW ROAD AND TRAFFORD ROAD

is always playing on the chain while working to insure efficient lubrication.

The connecting rods are of mild steel. The cross-head pins are case-hardened and are forced into the connecting rods by hydraulic pressure. The cross-heads are of the "marine" type, and are cottered to the piston rods. The slippers are of cast iron, and work under forced lubrication. The piston rods are of .4 carbon steel, and are ground up perfectly cylindrical.

The high-pressure cylinders are 15 ins. diameter x 30 ins. stroke, and are fitted with loose liners. Both the cylinders and the cylinder covers are steam jacketed with steam at boiler pressure. The high-pressure piston is of cast iron, fitted with plain "Ramsbottom" cast-iron rings. The bottom of the high-pressure cylinders and the top of the low-pressure cylinders are fitted with packings of the "United States" make, and are suitable for working with steam at a temperature of 100 degs. superheat. The valves of the high-pressure cylinders are of the piston type; the valve boxes are fitted with hard cast-iron liners forced in by hydraulic pressure.



MAIN TRACTION SWITCHBOARD AT SALFORD STATION

The low-pressure cylinders are 32 ins. diameter x 30 ins. stroke, and, like the high-pressure cylinders, are steam jacketed. The low-pressure valves are of the balanced slide-valve type; the clearances in the low-pressure cylinders are extremely fine. Both the high-pressure and low-pressure valves are driven from eccentrics on the engine shaft. The low-pressure pistons are of stamped steel, and are provided with plain cast iron "Ramsbottom" rings.

The speed of the engines is controlled by means of the governor acting on a throttle valve supplying steam to each high-pressure cylinder. The overload is obtained by an auxiliary throttle valve, worked from the main governor, which admits high-pressure steam to the low-pressure cylinders when necessary. A knock-off gear is provided for high and low speeds, which, in case of need, disconnects the throttle valve from the governor, and allows it to drop on its seat, thus shutting the engine down immediately should any accident happen to the governor.

All the handles of the drain cocks, speed gear, lubrication and stop valves are brought to one end of the engine frame, and are within easy reach of the attendant. The vertical rod of the stop valve is provided with a hand wheel on each platform.

The fly-wheel is 16 ft. diameter and weighs 18 tons.

The wheels are made in halves and are bolted and cottered together on the rim, and cottered in the boss; heavy steel hoops are also shrunk on the boss. The wheels are secured to the crankshaft by four steel keys. During tests made at the manufacturer's works the drop in speed from no load to full load was 2½ r. p. m., the temporary run up when all load was thrown off was 7 r. p. m.

Each engine has its own cast-iron separator carried on a bracket on the engine-house wall, the separator being provided with water-level gage fittings and with protector glass. The cylinders are completely covered with asbestos covering and lagged with planished steel.

The Salford Electricity Works has not only to supply current for the Corporation tramways, but also for the general lighting of the town. It was therefore necessary to design the dynamos so that they could be run as compound machines in the former case, and as shunt machines in the latter, and, further, to make provision for a possible considerable overload.

The normal output as a compound machine is 775 kw at a pressure of 525 volts; and as a shunt machine 775 kw at a pressure of 480 volts; but the machine will carry an overload of 25 per cent, thus bringing the output up to 1000 kw. The result is slightly over 95 per cent; the 5 per cent loss being made up of (a) hysteresis and eddy current loss 2.27 per cent, (b) C^2R losses 2.57 per cent, and frictional loss 0.16 per cent.

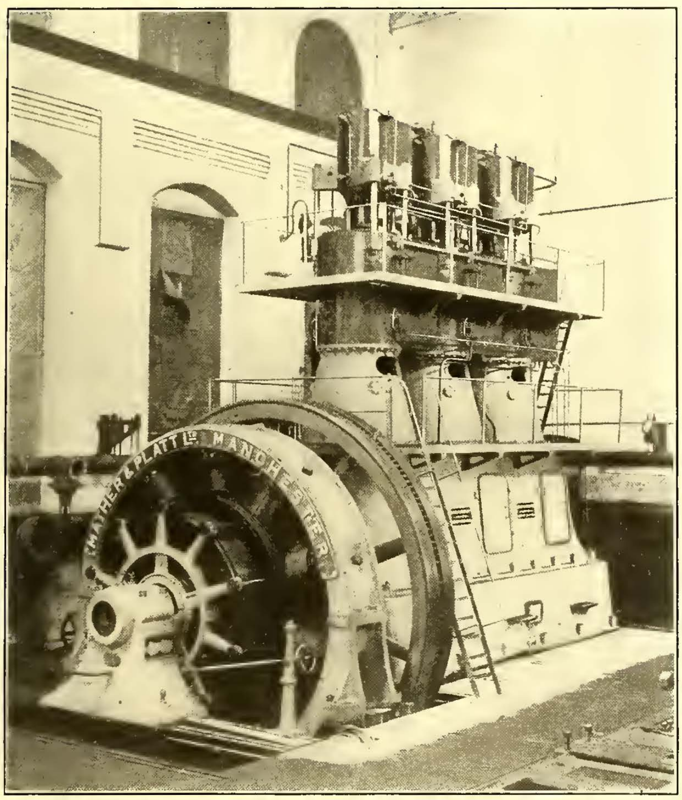
The boilers, of which there are sixteen, are of the Lancashire type. They are 9 ft. in diameter by 30 ft. long, and are built of ⅞-in. steel, the longitudinal seams being butt-jointed and double-butt, strapped with six rows of rivets. The circular seams are lap-jointed and double-riveted, and the boilers are designed to work at 160 lbs. to the square inch.

Each boiler is fitted with two flues, which are built of twelve rings, varying in diameter from 3 ft. 10 ins. to 3 ft. 9 ins., the last rings tapering to 38 ins. in diameter. Self-acting stokers and self-cleaning fire-bars are used. They are of the coking type, and each pair of stokers consumes 1 ton of fuel per hour. The stokers are driven by an electric motor, and the amount of feed can be varied by means of a special arrangement of cone pulleys. The use of these stokers has conclusively shown that they consume, to a very large extent, smoke, and work with great economy.

The economizers are clearly shown in the plan view. Each economizer contains 800 tubes arranged in six groups, four of these groups containing 120 pipes each, and two groups 160 pipes each, all of the groups being coupled by copper expansion elbows. In addition to the boilers and economisers, sixteen superheaters have also been supplied, with a guaranteed capacity to raise 10,000 lbs. of steam per hour, 100 degs. Fahr.

The steam pipes are of mild steel, the main pipe being 14 ins. in diameter. The main exhaust pipe is 18 ins. in diameter, the branch exhausts of each engine being 15 ins. in diameter. Each pair of boilers is directly connected to one engine, having a longitudinal by-pass provided, so that any boiler can be connected to any engine. Expansion is taken care of by the introduction of three expansion copper bends, each bend consisting of two 10-in. copper pipes fitted with cast-steel boxes. Garvie's patent steam and exhaust valves are provided, of the parallel-face type, with renewable expansion seats.

The air pumps and condensers are of the Edwards pa-

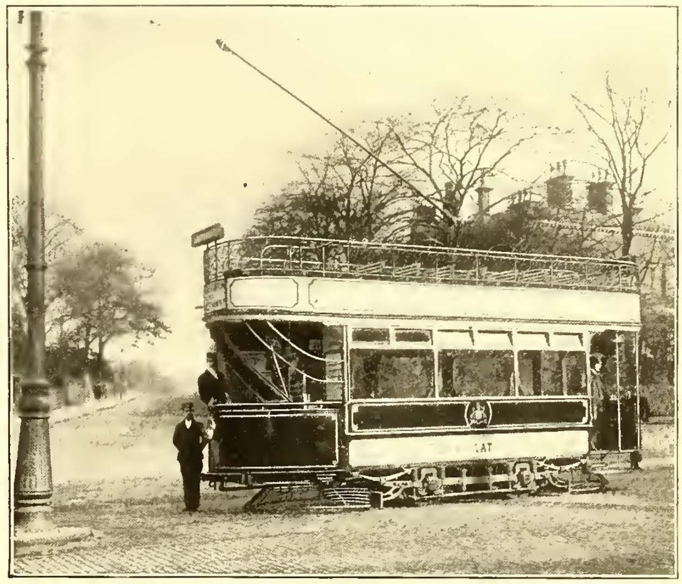


GENERATING UNIT

tent type. Eight of these pumps have been provided, each being of the three three-throw type, with barrels 21 ins. in diameter, 12 ins. stroke, running at 120 r. p. m., and each pump being capable of dealing with 18,750 lbs. of steam per hour. As is well known, these pumps have no bucket valves, and are extremely well adapted for work of this kind. They are intended to draw condenser water through a 20-in. suction pipe from the adjacent canal, and the discharge will be by means of a 40-in. pipe with six outlets to the canal. Each of the eight pumps are being operated by a 50 hp electric motor.

The following is a list of the contracts entered into for the supply and erection of machinery, together with names of the contractors and amounts of their contracts:

Eight 775-kw steam dynamos, Mather & Platt dynamos and Browett Lindley engines	£72,000
Sixteen 30-ft. x 8-ft. 6-in. Lancashire boilers and superheaters, Galloways, Lim.	15,200
Sixteen mechanical stokers, electrically driven, James Hodgkinson, Salford	2,495
Economisers, two batteries, comprising 1600 tubes in all, Green & Sons	2,860
Eight condensers and Edwards pumps, steam exhaust and water pipes, W. H. Bailey & Co.	16,500
Six electrically driven feed pumps and feed pipes, each delivering 4000 gals. of water per hour, Bertram Thomas & Co.	3,157
Thirty-ton traveling crane, 44-ft. span, 220-ft. travel, Jas. Carrick & Sons	622
Electrically driven ash conveyor, Graham Morton & Co.	1,569
Two electrically driven traveling jib cranes for coaling, Clayton Engineering Company	1,270
Overhead equipment for tramways, Messrs. George Hill & Co.	8,599
Underground cables for lighting and power purposes, including tramway feeders, W. T. Glover & Co., Lim.	159,648
Lighting and power switchboard, S. H. Heywood	2,280
Traction switchboard, John Fowler & Co.	2,684
Balancing transformers, Mather & Platt	1,060
Electrical connections in engine rooms, and signals, Lightfoot Brothers	4,179
Steel poles for tramway equipment, James Russell & Sons	17,450
Station lighting, Alliance Electrical Company	598
	£312,171



STANDARD CAR

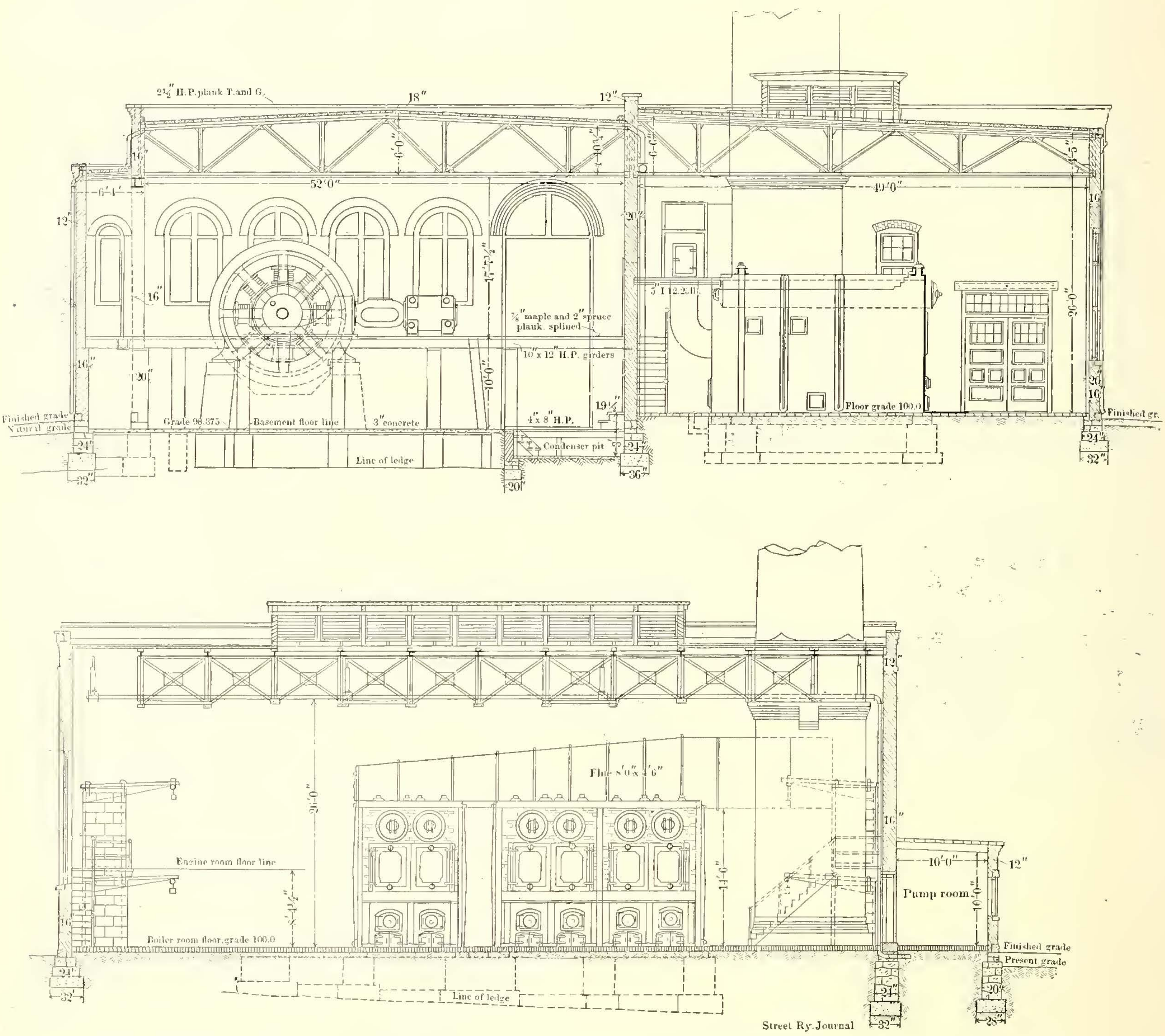
CENTER POLE CONSTRUCTION

The Hartford & Springfield Street Railway

Trolley tourists who have made the trip between Boston and New York by trolley car and have traveled over certain gaps in this distance by steam train will remember that one of the longest of these intervals in which there is no electric transportation is in Connecticut, between Warehouse Point and the northern terminus of the Hartford Street Railway Company. These short breaks in continuous electric track between Boston and New York are gradually being filled up, and the latest portion to be put in operation is that between the two points mentioned above, so that now a tourist or any other person who wishes to travel between Hartford and Springfield can make the entire trip by trolley. This has been accomplished by the completion of the Hartford & Springfield Street Railway, which was put in operation Jan. 13, and which makes direct connection between the local street railway systems in Hartford and Springfield, passing through the towns of Thompsonville, Warehouse Point and East Windsor.

The road is built principally on the side of the broad highway, but in many places private right of way has been purchased for the purpose of eliminating heavy grades and reducing curvature. The construction has been as thorough as it has been possible to make it, and the line will compare favorably with any electric road in the State of Connecticut. The old Enfield & Longmeadow Railway, which ran from the State line to Warehouse Point in Connecticut, was bought by the Hartford & Springfield Company, and has been entirely renovated both as to construction and location. The entire track has been taken up, realigned and at least 1 ft. of ballast placed under the ties. The overhead material has been entirely changed, new poles have been installed and every tie has been renewed.

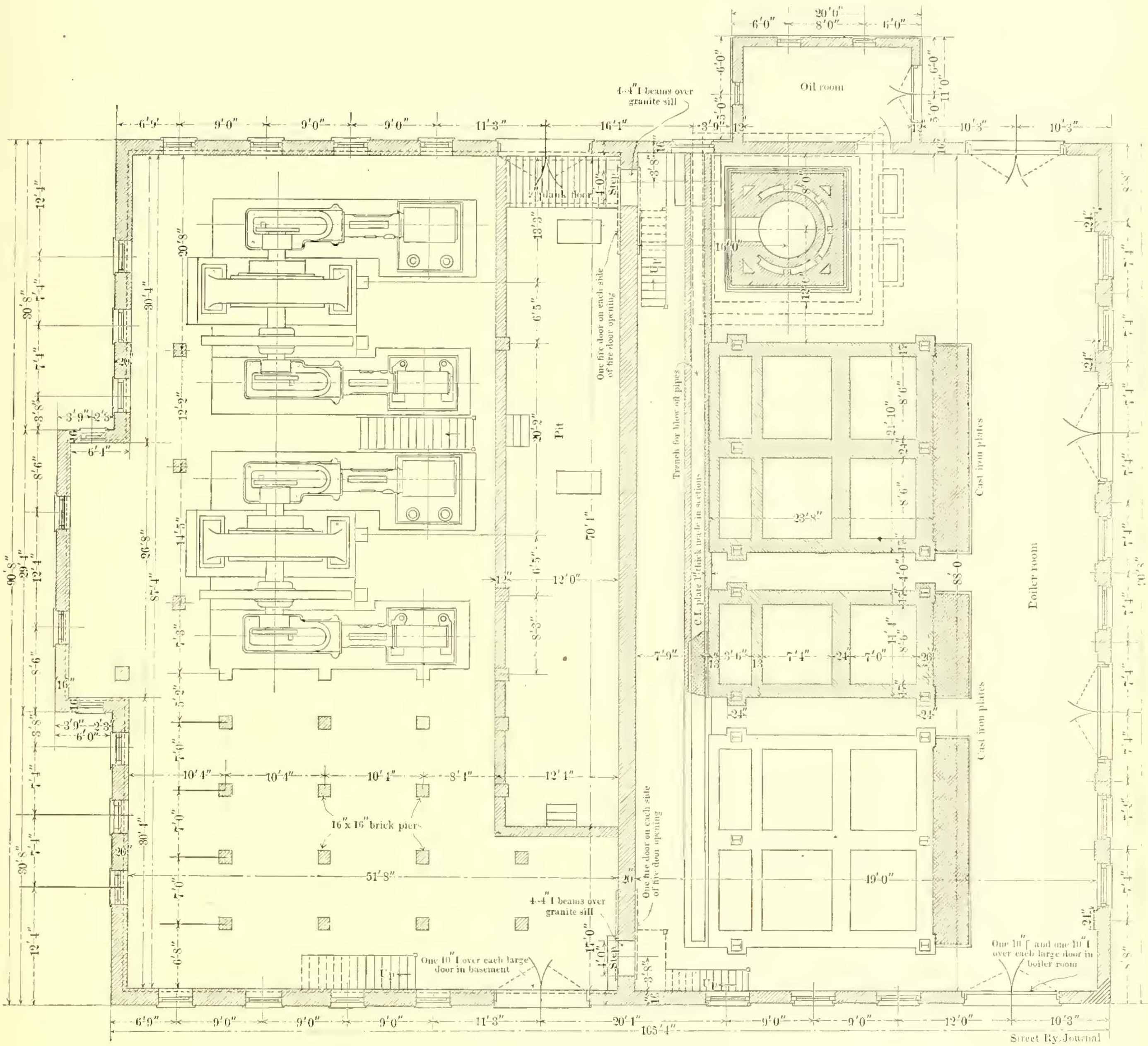
The total length of the new line is 13½ miles, from the State line to East Windsor Hill, where the connection is made with the tracks of the Hartford Street Railway Company.



SECTIONS THROUGH ENGINE AND BOILER ROOM

The entire construction is permanent—that is to say the stone culverts have been built in every place where streams are crossed, with the exception of the crossing over the Scantic River, near East Windsor Hill, where the company has put in about 200 ft. of wood trestle for temporary use only. It is the intention of the company to replace this structure at some future time by a steel bridge on stone abutments, and the trestle will then be filled in up to the abutments.

The company is planning to run a dual service on this road, namely, a through service with large cars from Hartford to Springfield, and a local service with smaller cars, which will start in Chicopee and run through Springfield, thence through the town of Thompsonville and return. This is done because the town of Thompsonville is not only a very flourishing and important little town at the present time, but with the growth of the Hartford Carpet Mills will probably, in the course of a year or eighteen months, be increased by anywhere from seven to ten thousand persons, and it is thought that this large population is entitled to better service than would be feasible through the entire line.



GENERAL PLAN OF FOUNDATIONS OF POWER STATION

For the through service the company has ordered from the Wason Manufacturing Company a car having length of 43 ft. 4 ins. over all. These cars are very handsome, and are made several inches lower than is customary, owing to the fact that there is an underhead crossing of the New York, New Haven & Hartford Railroad on the outskirts of Hartford where the clearance is so small that a special low trolley stand had to be secured from the General Electric Company.

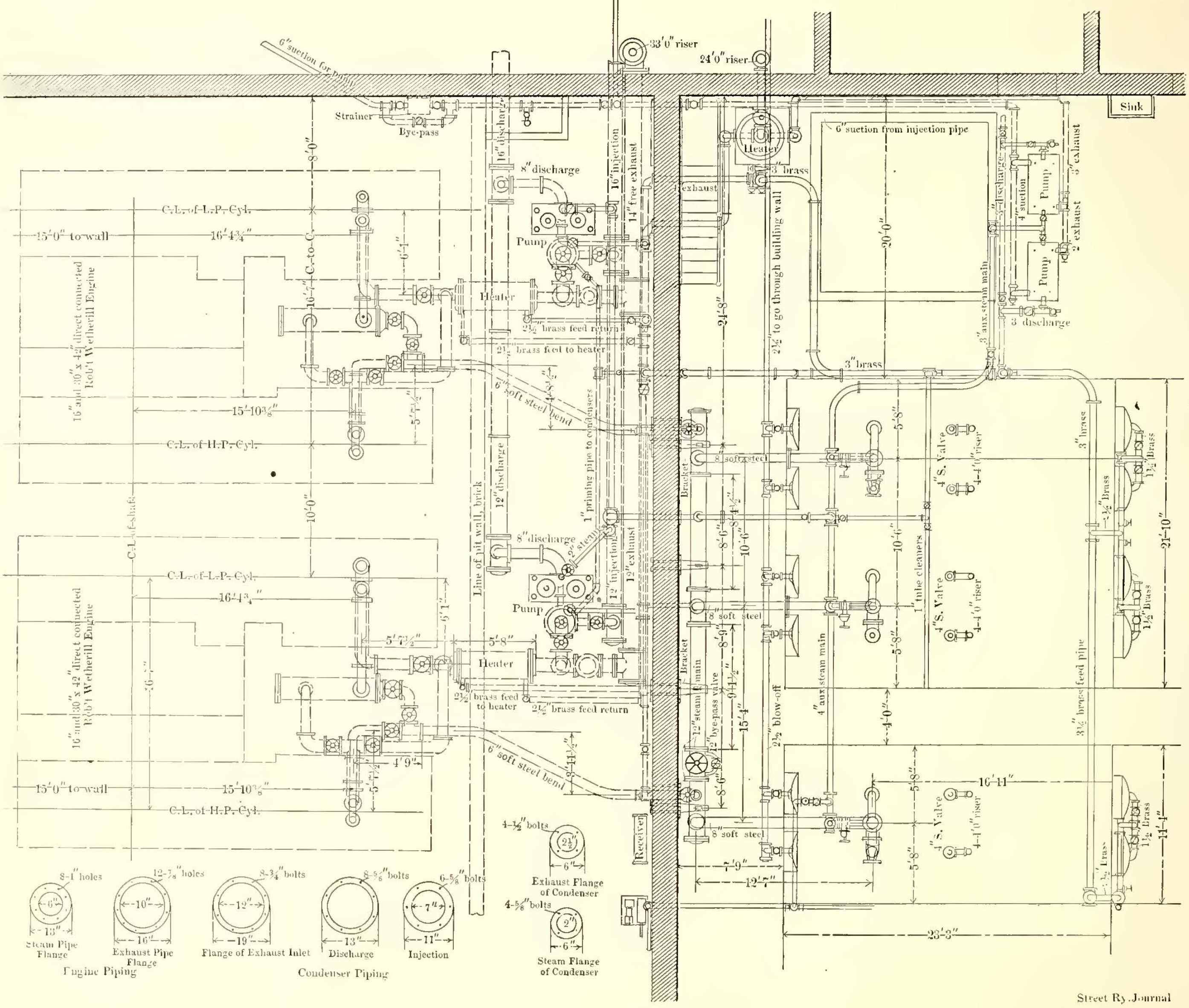
The cars have a smoking compartment and have a seating capacity of forty-one people. The woodwork is dark-stained quartered oak in the smoking compartment and selected mahogany in the other parts, the seats being of olive-colored leather in the smoking compartments and green plush in the rest of the car. Eight of these cars are used for the through service, and two cars, which will be somewhat shorter, but of similar design and appearance, will be employed for the Thompsonville service. All the cars are equipped with four G. E.-67 motors and are provided with the Christensen air brake, with independent compressor and whistle. New Haven registers are used.

The company has also a double-truck Ruggles rotary snow plow and a heavy nose plow, the former equipped with six G. E.-1000 motors.

The track is laid throughout with 70-lb. steel rail, A. S. C. E. standard section in 30-ft. lengths, with Weber joints. The ties are the usual 6 ins. x 7 ins. x 7 ft. tie, placed 2-ft. centers. The feeder wire is 500,000 circ. mil for the whole length of the road and No. 00 trolley with Craighead flexible brackets. For the bonding of the rail 8-in. stranded concealed bonds are used.

The power house is located very nearly in the center of the line on the banks of the Connecticut River, where there will be ample water all the year round for condensing purposes. It is a substantial structure of brick, with steel roof trusses and large windows and doors conveniently located for light and accessibility. The chimney is of brick and 130 ft. above the boiler room floor, and has a core 6 ft. in diameter for nearly its entire height.

The boiler room measures 51 ft. 8 ins. x 49 ft. 5 ins., and connected with it, as shown in the plan, is an annex to be used as an oil room. The engine room measures 91 ft. x 105 ft., and the floor of this room is 12 ft. above its basement. The engine room floor is strictly mill construction, the finish floor being rift hard pine laid in narrow widths.



PLAN OF PIPING IN POWER STATION

The station contains at present two cross-compound engines, made by the Wetherell Engine Company, of Chester, Pa., each direct connected to 300-kw, 500-volt, direct-current generators, made by the General Electric Company, and controlled by a standard switchboard of the latter company's make. Space is left for a third engine, to be installed in the future.

All pipings and fittings connected with the engine are in the basement under the engine room floor, hidden from view, which gives the engine room a roomy and neat appearance. In this basement are located the air pumps and condensers, heaters, etc. Exhaust steam from each engine is carried directly into an American feedwater heater, and then into a Knowles twin vertical air pump and condenser through the usual valves. In the basement is also located the receiver of the Holly system, into which all drips and water of condensation from the steam mains, etc., are collected and returned directly to boilers.

A pump and receiver also returns all the condensation from the heating system of the car house and office building, both of which are located in the vicinity of the power house and are heated from it.

In the boiler room are now located two batteries of boilers of the water-tube type, made by Aultman Taylor Company, of Mansfield, Ohio, which have a rated capacity of 750 hp, with space for 500 additional horse-power in the future. In this room are also two duplex double-plunger "Deane" boiler feed pumps, each of which is large enough to run the entire plant. An auxiliary feed-water heater is conveniently situated near the pumps, and receives the exhaust steam from all feed pumps, air pumps and the pump and receiver, the heat from which is used to increase the temperature of the feed-water before it enters the boilers.

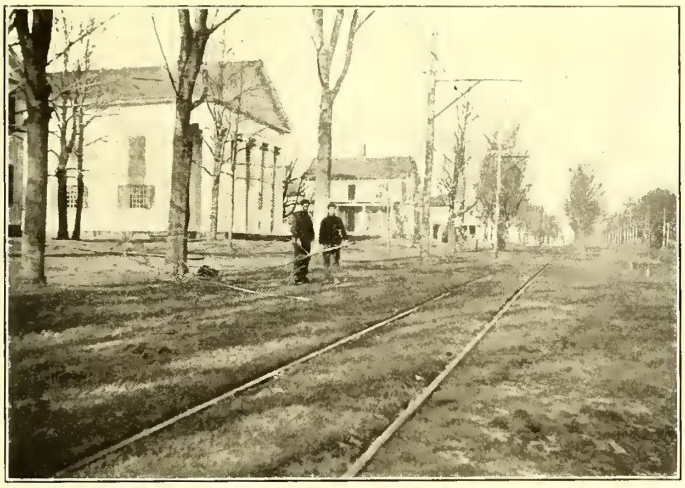
Special attention has been given to the entire piping system, and it represents the best up-to-date practice. The main is carried on adjustable roller brackets bolted to the building wall directly behind the boilers, and about 2 ft.

above the boiler room floor, so that all valves can be conveniently operated by hand from the floor. Long-turn steel bends connect this main to the boilers and the engines by short runs and extra heavy by-passed O. S. Y. valves, which provide amply for all usual expansion and contraction. The piping about the engines is so arranged that they can be run condensing or non-condensing, or either one or both sides independently of the other if required.

The free exhaust to the atmosphere is carried to the roof and topped with an exhaust head.

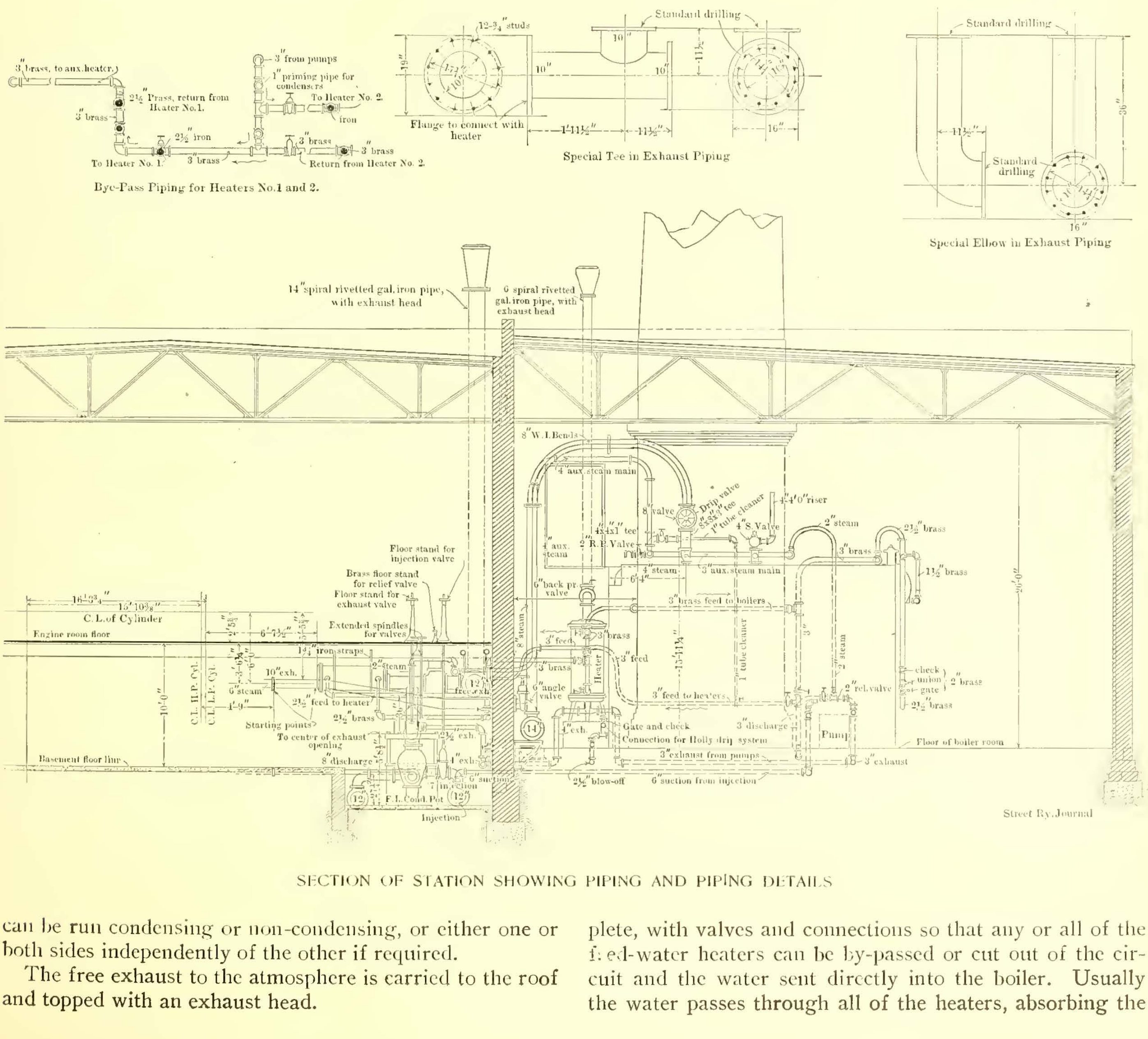
The condenser and boiler feed pumps take their water supply from a large "well" constructed with floodgates and overflow on the bank of the neighboring river, and the boiler feed-pumps are further connected for hot well in the engine room basement, as a secondary source of supply.

The piping to the boiler feed system is particularly complete, with valves and connections so that any or all of the feed-water heaters can be by-passed or cut out of the circuit and the water sent directly into the boiler. Usually the water passes through all of the heaters, absorbing the



VIEW IN ENFIELD

LONG MEADOW AT SWITCH

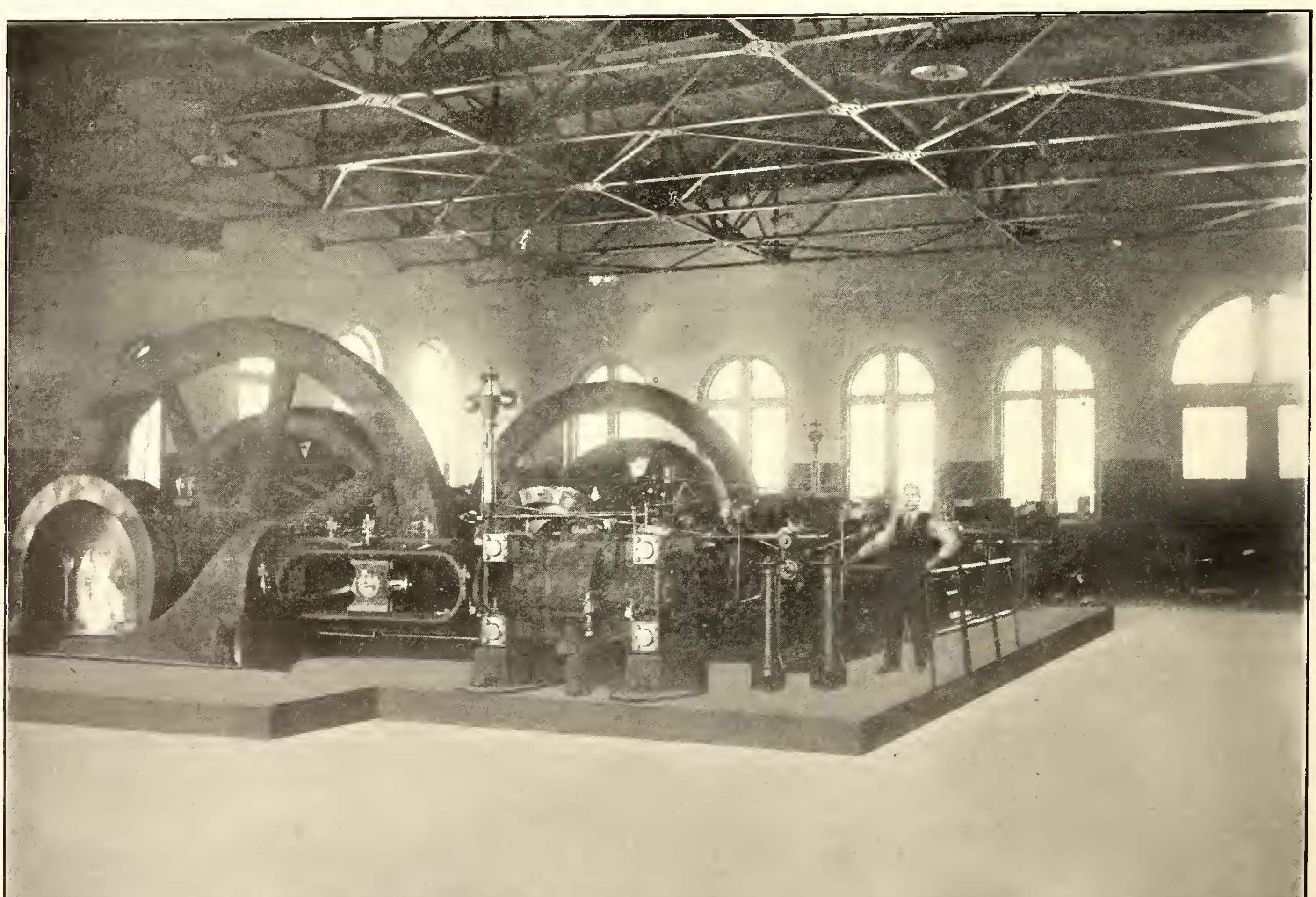


SECTION OF STATION SHOWING PIPING AND PIPING DETAILS heat of the exhaust steam from the pumps, which raises it to 200 degs. or over before entering the boilers. In this system are numerous long-turn bends and valves, so ar-

TRESTLE AND FILL AT SCANTIC RIVER

ranged that only a partial breakdown of the plant can be possible.

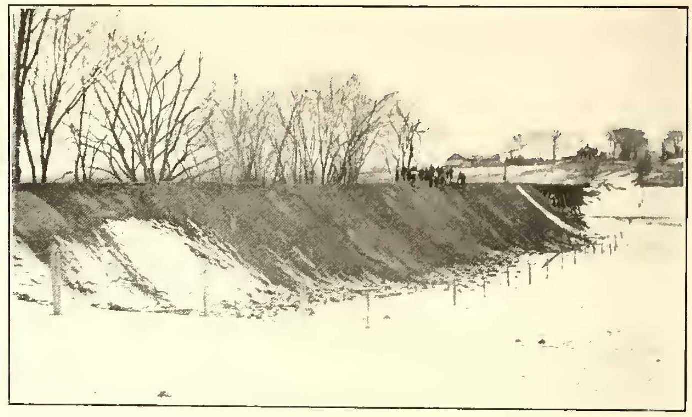
All steam and water pipes are to be covered with 85 per cent magnesia, furnished and put on by C. W. Trainer & Company, of Boston. The valves for this plant were furnished by the Chapman Valve Company and the Pratt-Cady



INTERIOR VIEW OF POWER STATION OF HARTFORD & SPRINGFIELD STREET RAILWAY

Company. All steam fittings are of the extra heavy pattern and mild steel pipe with "Vanstone" joints to all mains. The piping was installed by Andrew Lumsden & Company, of Boston. The car house is of wood, has a capacity for sixteen cars, is situated near the power station and is heated from the same by direct steam at reduced pressure.

The officers of the Hartford & Springfield Street Railway Company are: President, Philip L. Saltonstall; treasurer, Chauncey Eldridge; superintendent, George B. Larrabee. E. H. Kitfield, of Boston, designed the power station and car house throughout, and was represented in their construction by O. D. Rice, of Boston.



FILL AT EAST WINSOR HILL

Windows in Open Car Curtains

The Houston (Texas) Electric Street Railway has for some years past had several open cars equipped with curtains with round bull's-eye peekholes. The idea, of course, was to have an open car on which the curtains could be pulled down during the cold weather, which sometimes occurs in Houston, so as to make the open car into something like a closed car as to comfort. Of course, such a plan has the disadvantage that the curtains are inconvenient for passengers boarding and leaving the cars, and the car can hardly be called popular.

Street Car Platforms—III.

BY W. E. PARTRIDGE

The varied requirements of street, elevated, suburban and third-rail roads have brought out a great many designs for platforms, vestibules and cabs. In spite of their variety it can hardly be said that a final form has been reached even for lines of service which are fairly well settled. While much study has been bestowed upon the question of protection for the motorman and conductor, there are other conditions which are also of importance. It is not even considered entirely settled that any protection is needed for the rear platform. Some foreign roads have reached the conclusion that the motorman should be placed in a cab to which the passenger has no access. On the other hand, some American roads have made a large vestibule at the front end of the car, placed a heater within it, and appear to be contemplating the use of the forward vestibule as a smoking apartment. Other roads have placed their motormen in the same compartment as the passengers with no attempt at a screen between them.

Questions of seating capacity, accommodations for smokers, the operation of cars in one direction only, together with that of long or short service, are some of the more important that have to be considered.

The platforms and vestibules considered in this article are some which have been designed to meet special conditions. Others are called by the builders "standard," because they have been built so often and seem to meet such a wide range of service that the name may be well applied.

The electric railway of to-day is progressing so rapidly that details of construction which appear to have settled into a permanent form may in half a dozen years be as completely out of use and out of date as the horse car.

The discussion of the present methods of construction is especially useful because of its suggestiveness. When a designer is familiar with all that has gone before he is in the best possible position to turn out something new. This is an ample excuse for presenting the designs in this paper.

Fig. 1 shows a platform for a car intended to operate entirely on an elevated railroad, built for the South Side Elevated Railway of Chicago by the Jewett Car Company. The long platform timbers carry the platform load with a minimum strain on the end sills, and for this reason the construction is highly commendable. But in the original design for rolling stock a great improvement could have been made by raising the platform floor so as to bring it up to the level of the car floor. The advantage of such a construction would have been found in the enormous increase of longitudinal strength. The sills could then run straight through to the crown piece. If this was not desirable, short blocking pieces would transmit the buffing strains in straight lines to the sills. Elevated railway service is each year making a closer approach to steam road practice. For this reason, each gain in strength which can be made without adding to the weight is desirable.

This platform has some features which are not easily seen in the engraving, but as they are of importance, attention should be given to them. There is no dasher plate, its place being taken by a wire netting, not showing in the engraving, which comes up to the top of the gates. This is a somewhat unusual feature, but one in which there is a good deal of common sense. The gates themselves are very tall, being brought up to within a foot of the hood. They are hinged to the hood supports. When they are shut there is no such thing as climbing over them. For this reason, there is no temptation for the passenger to hang on to the gate with the hope of climbing over the gate while the car is in motion. No steps are provided, but there is the usual stirrup for employees to reach the platform from the track level.

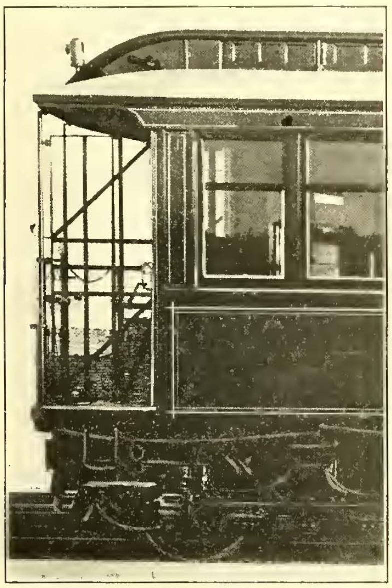


FIG. 1.—PLATFORM USED BY THE SOUTH SIDE ELEVATED RAILWAY CO., ENCLOSED WITH WIRE NETTING

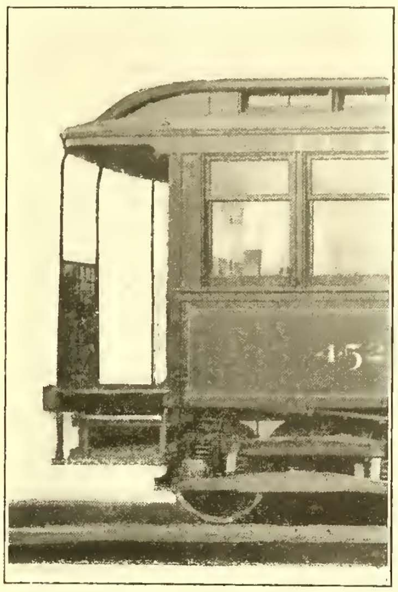


FIG. 2.—PLATFORM OF BROOKLYN RAPID TRANSIT CARS

FIG. 3.—INTERIOR OF OBSERVATION COMPARTMENT WITH VESTIBULE

The longitudinal strength may be ample for the ordinary strains of service, but there are collisions which may happen. Railway men are fond of saying, "We do not build for accidents." That is true, but accidents are very sure to come, and when they do come and there is a loss of life or limb, the cost to the railway company is enormous. In the recent accident in the Park Avenue tunnel in New York City the ultimate cost to the New York Central & Hudson River Railroad will be very much greater than would the cost of constructing these cars in such a way that telescoping would be out of the question. Those who have not investigated the subject will say it is impossible to build cars so that they may resist the force of a locomotive going 35 miles per hour. But cars can and are built so that they can, with safety to their passengers, receive such shocks. In the case in hand, the raising the platform and giving the end of the platform the full support of the sills would produce a power of resistance which it is not easy to calculate. In case of a collision this might, and probably would, mean the difference between a serious and a trivial accident. Some roads seem always to escape serious accidents. This is really because they build or buy strong cars. Neglect of a small detail of car construction may easily cost a road a hundred thousand dollars or more.

The Brooklyn Rapid Transit platform, shown in Fig. 2, by the J. G. Brill Company, illustrates the point just mentioned. The floor of the car and that of the platform are both at one level. For this reason, a blow on the crown piece is not likely to carry away the platform. It would only be from blows heavy enough to smash timbers that the platform would suffer. Here the side sills do not run all the way through, but the platform, nevertheless, becomes practically a part of the floor frame of the car. In elevated service switching is inevitable, and cars are usually operated in trains. Endwise blows, some of them pretty heavy, are constantly encountered. An ample margin of strength is neccessary in order to avoid constant platform repairs. Or if they are to be met by using the usual street car construction, an unnecessary weight will be required. On these cars the gates fold against the dasher railing, which has an opening to allow passengers to go from car to car. Here a trivial detail is to be noticed; on each side of the opening the post is carried up and formed into a hood support. Its value as a hand hold for passengers is very great, because it gives a "grab handle" at just the right height for every individual. It is well to remember that every trifle, if it adds to the safety of the passenger or tends to prevent accidents, is well worth attention. A single accident may cost much more than the price of equipping a whole line with some device which would have prevented injury to passengers or property. When a trifling change in the design of a detail costs nothing, and at the same time is likely to prevent accidents, it is certainly advisable.

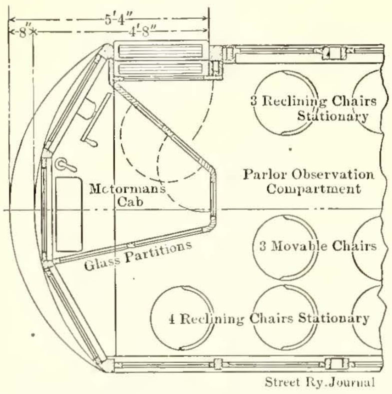
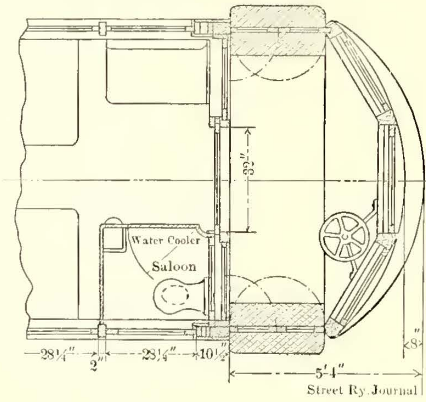


FIG 4.—ENTRANCE AND VESTIBULE FOR THE DETROIT, LAKE ORION & FLINT RAILWAY



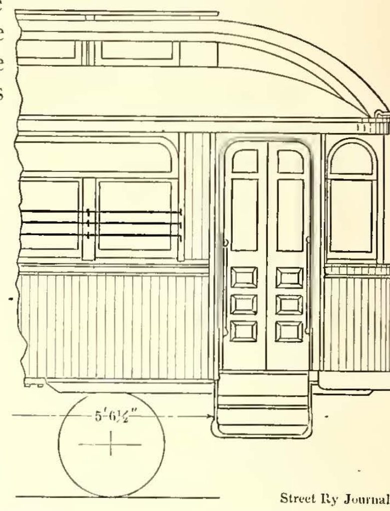


FIG. 5.—PLAN AND ELEVATION OF COMPLETELY ENCLOSED VESTIBULE

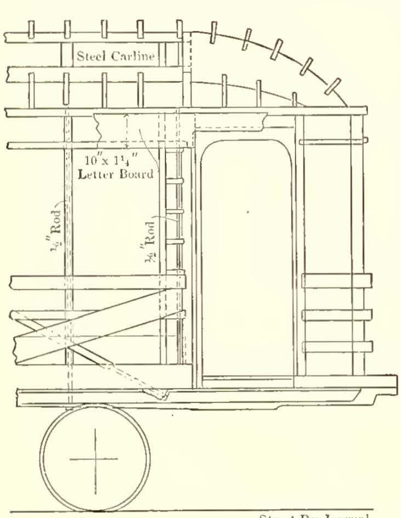


FIG. 6.—FRAMING FOR VESTIBULE SHOWN IN FIG. 5

Fig. 3 shows a peculiar combination of vestibule, motorman's compartment and observation room, built for the Grand Rapids, Holland & Lake Michigan Railway by the G. C. Kuhlman Company. The platform is compressed until it is little more than a step at one side. The motorman has just space enough to stand and operate the brake wheel. The latter, on account of limited space, has to be placed in a vertical position. It operates through bevel gears. On the side opposite the entrance there is space for a double seat. The end of the car forms the front of the vestibule, as it may be called. The front glass on the observation side should either be double, the best plan, or fitted with unusual care, otherwise the exposed position will cause annoying drafts in cold weather, which will be expensive, because they will make the car difficult to heat.

This modification of the vestibule makes a considerable increase in the seating capacity of the car. The gain, however, is reduced by the necessity for a separate compartment for the motorman. One remedy for this might be found in giving the motorman an elevated cabin, in which he sits with his hand nearly on a level with the trolley stand. In a sitting position the motorman can exert more force on a ratchet brake or a lever brake than when standing, and he can handle his controller with as much speed. When air or other power brakes are employed, the sitting position has the same advantages for the motorman as for the locomotive engineer. In an elevated cabin he would have a better view and be out of the way of passengers, who often distract his attention when they ride on the platform. With such a cabin properly designed he would have a better view of the street, and would be better able to prevent accidents.

On a special car for the Detroit, Lake Orion & Flint Railway the Jewett Car Company built a vestibule or end entrance very similar to that just shown. A plan of it is given in Fig. 4. Here stationary chairs are used instead of seats with reversible backs. The motorman has, apparently, a trifle more space than in the previous instance. In both cases the end of the car frame is carried out to the front of the vestibule. In both styles a vertical brake wheel is employed to save space. This seems to be a matter of convenience rather than necessity, for there is room for a horizontal wheel if one were necessary. In the standard platform of the Jewett Car Company the horizontal wheel is used, see Fig. 5, which shows elevation and plan of the vestibule which they use on large cars.

Although the platform floor is dropped a little below that of the car, the whole thickness of the crown piece comes on a line with the sills. With the introduction of a suitable blocking this makes a very firm construction. Any blows upon the buffer are taken in a direct line by the end sill of the car. The design is so practical, and at the same time so simple, that we introduce it in Fig. 6. It illustrates the general tendency in elevated and other high-speed electric cars which have to be operated in trains.

The vestibule shown in Fig. 7, built by the American Car Company for the New Jersey & Hudson River Railway and Ferry Company, is unusually roomy and has a wide entrance. It is of the strictly electric road type, having a plain clam shell hood. The platform timbers are plated with iron, so that the length is easily supported. The photograph does not show the construction clearly, but apparently the platform floor is dropped so far that the buffer iron receives no support from the end sills. This platform has a single step with apparently a 14-in. or 16-in. riser, which, in all probability, is 18 ins. or 19 ins. from the head of the rail. By raising the platform a few inches so that the crown piece would be in a line with the end sills two steps could have been used to advantage, the lower one

FIG. 7.—ROUND END VESTIBULE WITH PLAIN CLAM SHELL HOOD

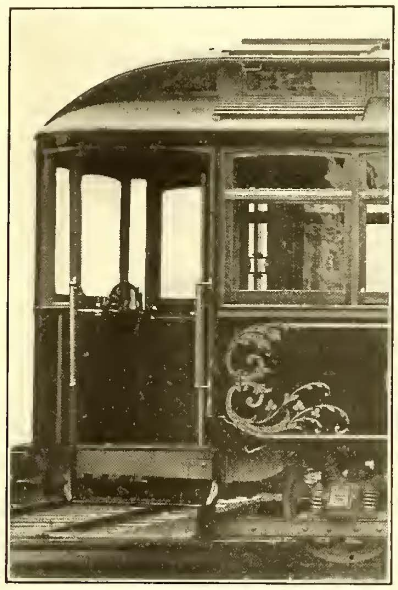


FIG. 8.—VESTIBULE WITH VERTICAL BRAKE WHEEL; DOUBLE FOLDING DOORS ON EACH SIDE

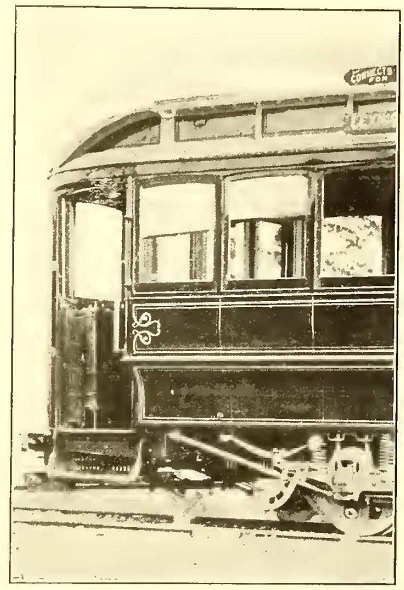


FIG. 9.—PLATFORM WITH BOTH DOORS AND GATES: GATES FOLD INSIDE OF DASHER

about 13 ins. from the ground. Two steps, where the lower one is broad and low, make it easier and quicker for the passenger than a single step 19 ins. or 20 ins. above the head of the rail and a proportionately higher riser.

The vestibule shown in Fig. 8 is one used by the Stephenson Company for the People's Railway on a lot of eight-wheel cars. These platforms are 4 ft. 6 ins. long, and have double folding doors on each side, both sides of the car being used for entrance. There are three large sash in front. These drop in the usual way. It will be noticed that a vertical brake wheel is used. This is rather a novelty on electric cars of standard types, though common enough in steam road practice. Its advantages are such as to make it a desirable feature. When it is used, at least two more persons can find standing room on the platform than is possible where a horizontal wheel is employed, and where a brake handle is used the gain of space is quite as great. With the ordinary handle, the brake staff has to be carried well out from the dasher on brackets.

It is only fair to say that a few motormen complain that the vertical brake wheel is not quite as quick as the common ratchet handle, and for this reason do not like it as well.

The disposal of the gate, with a completely enclosed vestibule, is not always an easy matter. The doors themselves take up some space, even when they fold, which is general practice. The gate is, therefore, often made to swing back against the outside of the vestibule. This does not make a very neat appearance, but is fairly convenient. One railway company in the State of New York reports a strange accident from a gate which folded outside the dasher. In attempting to board the car, a ring on a man's finger caught in the points of the folding gate and the finger was torn off. Future accidents of the same kind were guarded against by using a cap to cover the top of the gate when folded back. In Fig. 9 a gate is shown folding neatly against the inside of the dasher. The vestibule is of the semi-circular type, having both doors and gates on each side. The doors close against the body of the car. In Fig. 10 is shown another completely enclosed platform, which, like the last, is by the Stephenson Company, with doors folding against the dasher. Gates, however, are not employed. Occasionally, sliding doors may be used for vestibule entrances. These are made both curved and straight, with curved and straight tracks. When the latter are employed the track is in two parts, which are set at an angle to each other. When not closed, doors take up considerable space, and where a vestibule is fitted with them a few inches extra length may be given to the platform with advantage.

Copying from transatlantic practice, central openings have been made in some American elevated cars, and then by a succession of modified forms we have reached cars having what may be called a central vestibule.

It will be of interest to consider for a moment the question of the central opening in the side of a car from a mechanical point of view. It had its origin in the railway coach, which in England and on the continent has until quite recently consisted of a series of coach bodies set upon a frame. The objection to the side entrance is chiefly because the opening destroys the strength of the side, and in case of accident the car goes to pieces. For this reason, there should not be doors in the sides of passenger cars that are to be operated at speeds above 10 miles or 12 miles per hour. It is an interesting fact that on elevated railroads in this country, where the cars have only end entrances, the stops are shorter on an average than on the underground roads of London, England, where the carriages have side entrances only. The movement of passengers along an aisle is apparently more free and rapid than between seats.

In giving a street car a center vestibule it is by no means deprived of its central aisle. The primary object of the design is to provide a single entrance for passengers that may be easily controlled and watched by the conductor. On elevated railways the central door is used with the idea of giving more rapid egress for passengers.

On reference to Fig. 11, which shows an elevated railroad car for Boston, built by the St. Louis Car Company, it will be seen that the door, of the sliding type, is situated in the center of one side. If the passengers are equally divided

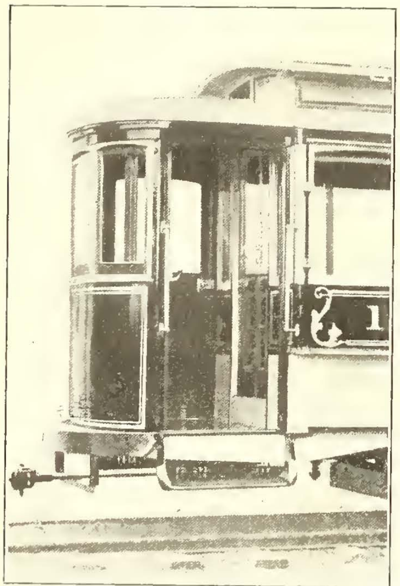


FIG. 10.—DOORS FOLDING AGAINST DASHER

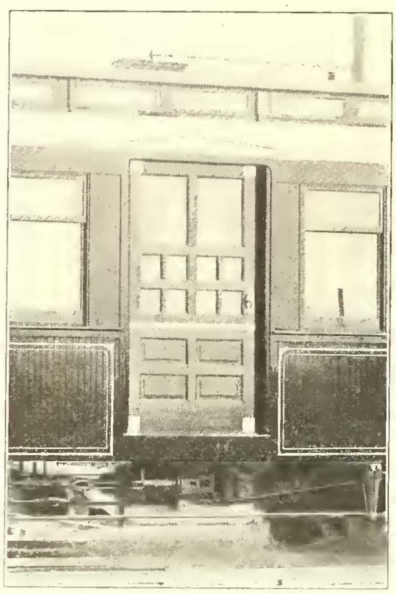


FIG. 11.—CENTRAL ENTRANCE FOR ELEVATED RAILROAD CAR

in their choice of exits, between the three doors available, the saving in distance which they have to travel before reaching the platform of the station, will average only one-fourth the length of the car. The disadvantage which is met in a central exit is that two streams of people going in opposite directions come together at the door. This probably more than offsets the gain by an additional entrance. A wide entrance to the platform, giving space for two persons to step from the car at the same time, is probably a far greater advantage than the central door. The final objection to the side entrance is the great loss of seating capacity which it entails. Efforts have been made to overcome this, but it can hardly be called successful for elevated roads, where the entrance may be from both sides of the car on a single trip. It may be pretty safely assumed that the standard form is the best and most economical car for elevated roads.

Many designs have been tried in the United States, looking toward cars with single entrances, on one side only, for ordinary street car service. Of course, in collecting fares, the conductor in such a case is much nearer the entrance, even when at the extreme ends of the car than he is in the ordinary type. There is also another advantage that the passenger cannot get off or on at the wrong side.

The earliest design of this type which we have happened upon is that shown in Fig. 12. It was built by the Brill Company for the Lindell Railway of St. Louis. The car has a curved side, with a sub sill under the doorway, the central platform being dropped. There were in effect two closed bodies united by a central platform, which was open upon one side. The car was, however, provided with seats opposite the door or entrance. It was mounted upon double trucks, and ran in one direction only. At one end there was a cab for the motorman. The ends of the car presented rather an odd appearance. They had neither platforms nor even a buffer beam. For the pedestrian, however, it was quite as safe as the modern fender. It carried a life guard close down to the track. This was suspended from the main member of the truck frame. The space on each side of the step was protected by a heavy wire guard of fine mesh.

Sometime afterward the Brills made another attempt along the same lines for a Florida road. The opening in the side of course greatly reduced the strength of the car, and means had to be provided to make up for the loss of stiffness. Fig. 13 shows how this was done. The sides of the car were made nearly or quite straight, and a heavy sub sill was placed beneath the door and extending some feet on either side. Additional strength was gained by the heavy top chord of the truck. Two steps were used which projected bodily outside the line of the car body. The arrangement of the ends was quite different from the car shown in Fig. 12, the end was curved or rounded, and there was a complete, though very narrow, platform, but no entrance from the car body to this platform, which had the buffer block then in fashion, and a regular steam car hood. The rheostat controller was placed out of the way beneath the body of the car. There were no platform steps, only stirrup irons. One end of the car was closed from the platform by sliding doors. The other compartment was open to the platform, but the platform opening was closed by a sliding door. By reason of the straight

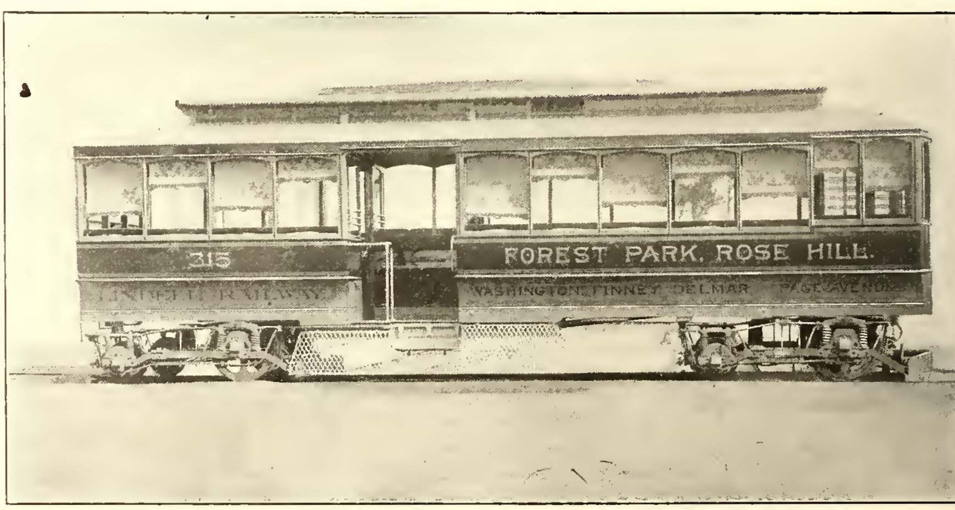


FIG. 12.—CENTRAL VESTIBULE, NO END PLATFORM NOR BUFFER BEAM

side it was possible to bring this door close out to the sill. At the time this design was brought out it appeared very promising, and much was hoped for it. It had the advantage of two compartments and but little loss of seating capacity. The design dropped out of sight, however, and so far as we know there have never been other cars like these built for use in this country.

The central vestibule or platform is by no means dead, however. Numerous other forms have been patented. Some of them have been elaborate, involving the feature of a double-deck car. Perhaps the latest, and certainly the most interesting, is the practice of the the Denver City Tramway Company. It is most interesting, because it is in actual service. As most of the readers of the Street Railway Journal know, this company has extensive shops in which it does a large amount of construction. Fig. 14 shows the central vestibule and steps of one of their new extension cars. These cars, of which the company has several patterns, have been made by joining an open car to a regular closed car body. In all these cars the main entrance is placed in the center of the car, with steps on both sides. The closed body in this particular case has an opening on the left-hand side in front, as is shown in Fig. 15. This has folding doors and the double steps which are used at all the platforms and vestibule openings. The open part of the car is entirely closed at the outer end. Details of construction are not at hand, but, judging from the photographs, it would appear that in combining the two cars the strengthening sills were placed inside the side sills of the cars. This method of construction enabled the projection of the steps to be very considerably reduced.

Another style of central platform used by the same company is shown in Fig. 16, where the steps are made nearly double the usual width. This car will be very quickly emptied at terminals, on account of this width, and also because the closed portion has a standard platform with steps on both sides like the central vestibule.

The central-entrance idea in connection with combination cars has been rather popular with some English tramways, and not long since the Brills were called on to design a car of this kind that would meet the special requirements of the English service. It was necessary to make the bodies as narrow as possible. The cars must

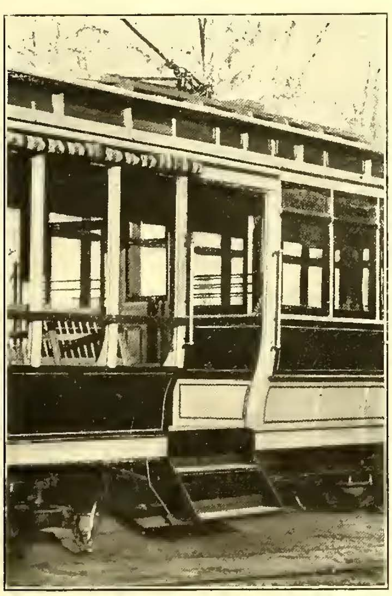


FIG. 14.—COMBINATION CAR WITH CENTRAL VESTIBULE

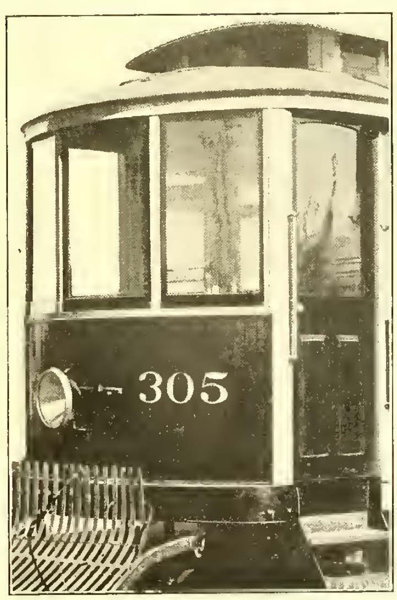


FIG. 15.—SINGLE END ENTRANCE TO CAR WITH CENTRAL VESTIBULE

FIG. 16.—WIDE CENTRAL PLATFORM, DENVER COMBINATION CAR

have two compartments, open and closed. The seating capacity was of necessity about the same as that of the double-deck cars, while the length was limited. It was for these reasons that a central vestibule seemed necessary, but the difficulties in the way were great. The body had to be narrow, on account of the limited width in the streets. For the same reason it was necessary to keep the steps in line with the body, and, as the entrance had to be on both sides, the side sills had of necessity to be cut through at a point where the body, by reason of the opening, afforded no strength whatever. This was done in an ingenious, and what has since proved to be a most effective, manner. The construction is shown in Fig. 18. The sill is cut off entirely, and the steps are set back so as not to project. There are two risers. A heavy U-shaped iron then connects the two parts of the sills. Its ends are firmly bolted

FIG. 13.—CENTRAL VESTIBULE WITH TWO STEPS

to them, so that the whole structure becomes as stiff and strong as though the sills ran straight through from end to end. This structure is made especially effective by plating the sills with steel.

The seating capacity is increased by putting into the vestibule a sliding walkover seat. This is shown in Fig. 18, pushed over to the further side of the car. A better idea of the arrangement of the central platform is obtained from Fig. 19, which also shows the inside doors of the outer platform or motorman's cab. As the car has to have entrances on both sides, it was necessary to make the platform seat movable, in order to have the space available. The tracks on which it slides can be seen near the threshold in Fig. 19.

In order to bring the length of the car within the limit the end platforms for the motormen are shortened as much as possible. Fig. 17 gives a side view of it, and shows how, by a V-shaped arrangement of the door and partition, he stands partly within the body of the car. A large man could hardly find room for a vigorous application of the brakes. The design permitted the length of the car to be brought within the required limits.

It is always profitable to study the methods by which engineers in other countries produce their results. The vestibuled platform on the Continent of Europe is a very

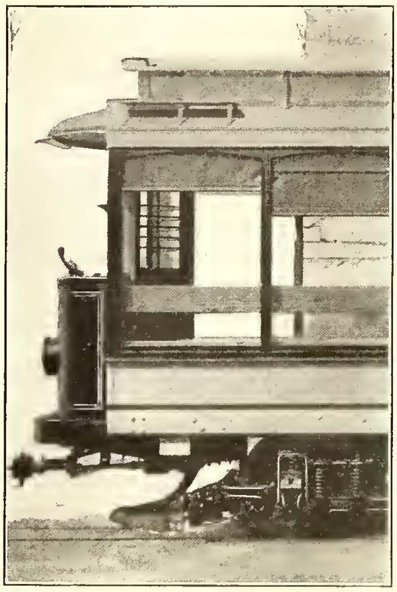


FIG. 17.—THE MOTORMAN'S PLATFORM FOR CAR SHOWN IN FIG. 18

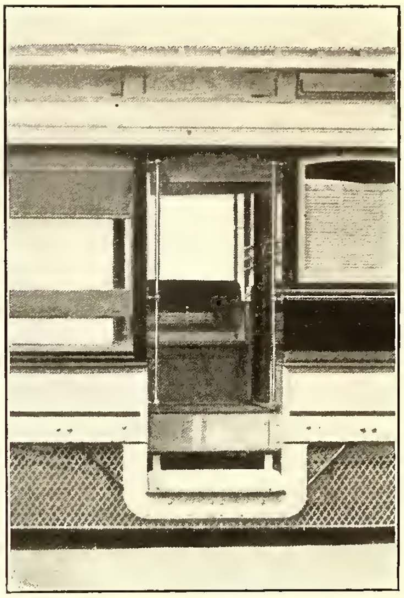


FIG. 18.—CENTRAL VESTIBULE, SILL STIRRUP

FIG. 20.—THE VESTIBULE OF A HIGH SPEED THIRD-RAIL EUROPEAN CAR

different affair from anything with which we are familiar in America. European engineers in many cases follow lines of reasoning entirely novel. Conclusions which habit and fashion has made final in this country are not accepted by them. They frequently assume novel points of view, and reason accordingly. An interesting illustration of this is found in Fig. 20. Here we have a vestibule and cab on a high-speed electric car operated on a third-

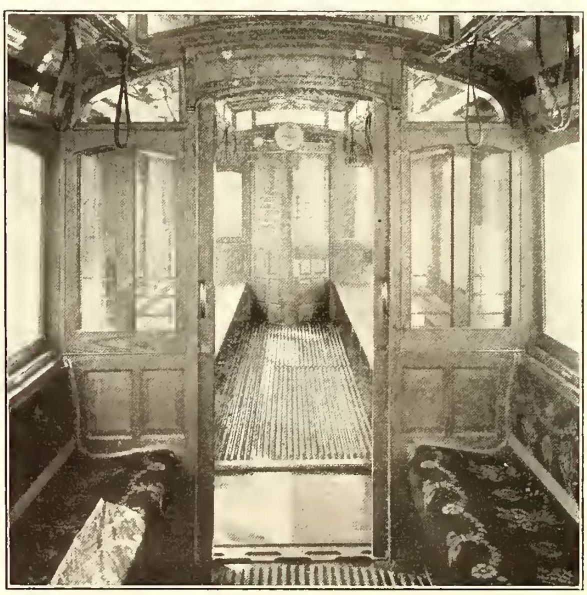


FIG. 19.—INTERIOR OF CAR SHOWN IN FIG. 18, SHOWING TRACK OF SLIDING SEAT AND BACK OF MOTORMAN'S PLATFORM

rail system near Milan, Italy. The whole structure appears strange to the American street railway man. The steam-car roof is, perhaps, an exception. The vestibule is so long that it has liberal sides, as well as a door, and a side sash nearly as wide as the door opening. In front there are the three sash, very much the same as in much American practice. In fact, the front has no resemblance to anything used here. The central sash is made very narrow. Those at the sides are as broad as possible. The idea is evident. The American theory, which is to give the motorman the best and most open view in front, is not accepted. Dangers come from the side; signals are at the sides. Therefore, the most unobstructed vision should be on diagonal lines, and not straight forward. So the broad glass is put in the side sash, and a narrow one is placed in front. The sides of the car are curved, like our street cars.

The controller and other apparatus within the cab make it less roomy than it appears outside. There are three steps, the lower one being broader and longer than the others. Details are not at hand in regard to the size of wheels, but the number of steps would indicate 42-inch. The upper half of the left-hand sash is hinged, probably so as to have a clear space at the top. The sash on the right is not divided.

The three steps show that the car is to be employed in a service similar to that of steam roads. The number of headlights appears to be a little extravagant, but they are used in a system of signals, so that this can hardly be criticised. As the car has iron sills, and as they are carried through to the buffers, the structure is admirably strong. The center of the buffers comes on a line with the center of the sills, so that all strains are transmitted in straight lines.

Power Station Improvements at Kansas City

The new power plant of the Metropolitan Street Railway Company at Kansas City, Mo., and located at Eighteenth and Olive streets, will be in operation in about two weeks. Two rotary converters of 750 kw each are being put in, and will be driven by the 2000-hp engine that drove the old Eighteenth Street cable before the line was changed to electricity. The converters will be used, for the present, as direct-current generators, delivering 1300 amp at 575 volts. When the new high-tension plant that this company is building is completed this station will be used as a sub-station. The converters will then be put to the work they are designed to do. Rope transmission will be used. The fly-wheel is 24 ft. in diameter, the pulley being 66 ins. The distance between centers 30 ft., and there is considerable speculation among engineers as to whether or not the rope transmission will work under such circumstances.

Progress in Street Railway Track Construction

BY CHARLES S. BUTTS, C. E.

In the early days, when street railroading was in its infancy, the rail adopted was a flat or tram rail, weighing about 30 lbs. per yard, in 20-ft. to 30-ft. lengths. This rail did not have any fish-plates, but was spiked to 6-in. x 6-in. stringers, 12 ft. to 16 ft. long and dapped at the ends. The spikes used were ⅝ in. x 3½ ins., and were countersunk into the flange, the rail was kept to gage by cross stringers every 10 ft. or 12 ft., dapped and nailed to the rail stringers. The ballast under this track was an unknown quantity, mostly mud. While this rail has given way to the girder rail, it is still in daily use in portable cross-overs, and was a short time used on bridges and for car-house entrances.

This rail was replaced by what was then thought to be a substantial and permanent construction, which consisted of girder rails weighing 38, 45 and 52 lbs. per yard. These rails were laid on 4-in. x 6-in. x 6-ft. oak ties, spaced from 4 ft. to 6 ft. apart and spiked direct to the tie with ⅝-in. x 3½ in. spikes. The ballast used was a combination of rock, gravel and dirt, mostly the latter. As the depth of these rails was only 3½ ins. to 4 ins., no room was left for any kind of improvement except boulders. When this rail was used in paved streets, the ties were lowered and a 4-in. cast-steel or malleable iron chair was used, thus giving from 7 ins. to 8 ins. for the pavement required by city ordinances and franchises; these chairs had lugs or clamps which held the base of the rail tight and were spiked to the ties. The fish-plates used were 4-holes, with a ⅝-in. x 3½-in. bolt.

When the horse lines were changed to electric, most of the 38-lb., 45-lb. and 52-lb. rails were left in and bonded with copper wire, and very often iron wire, and an extra 5-in. x 7-in. x 7-ft. tie was placed between those already in. The track being then resurfaced was considered in good condition to withstand the weight of the single-truck electric cars. It soon developed, however, that the increased weight and speed of these cars made it necessary to raise and retamp the joints. When the chair construction was used it was very difficult to keep the track from spreading, as the chairs would cut into the ties, the spikes would loosen and come out, and the inefficiency of the light rail and bad bonds to carry the return current soon showed itself in the spike holes in the chairs and at the points where the chairs came in contact with the rail. After repeated efforts to keep the track to gage a tie-rod was used every 10 ft. or 12 ft., which gave satisfaction. When this rail was taken off of a trunk line it was often considered good enough for an extension on the suburban end of another line. When taken up and relaid, however, this rail gave much less satisfaction than it did in the trunk line. It had a bad camber in it that could be taken out only with a rail bender or by rerolling. With such conditions low joints were inevitable.

The trunk lines were then given a 6-in., 70-lb. to 78-lb. rail, in 30-ft. lengths, laid sometimes with broken, and again with even joints; 6-in. x 8-in. x 8-ft. oak ties were used, spaced from 2 ft. to 2 ft. 6 ins. centers; brace tie-plates were installed, put on every third or fourth tie; 6-hole fish-plates, with ¾-in. x 3½-in. bolts and 9-16-in. x 5½-in. spikes were used, and were bonded with copper wire. The ballast consisted of gravel or rock, and in most cases whatever material was found in the old track was used for tamping and refilling, and when the track was relaid it had, in many cases, to be lowered to fit the grade established by the city. The joints of this rail have given almost as much trouble to maintain as with the lighter sections, and after many attempts it is found necessary to adopt for it some substantial rail-joint, or weld the joints.

In the early days the street railway company, when it did its own paving, did not think it necessary to use a concrete substructure. The result was that the pavement between the ties would sink, and the location of the ties could be told from the consequent depressions. At present concrete is recognized as very desirable as a foundation for pavements in the tracks.

The foregoing sections are now giving way to the 9-in., 90-lb. to 95-lb., 60-ft. length rail. This rail was and is yet being laid, similar to the 6-in. and 7-in. construction, only in many cases tie-rods are used instead of tie-plates, the rail being spiked direct to the ties. The angle-bars used are 8-hole and 12-hole, with 1-in. x 3½-in. bolts. It would hardly seem possible when laying this track upon oak ties ballasted with rock that a joint would ever go down, but time has developed a drop of perhaps 1-32 in. to 1-16 in. in the ball of the rail. This can be noticed both by riding over the rail and also by examination. It will also be found that the fish-plate has a depression corresponding to the ball of rail, and that the ties are cut. These conditions take time to develop, but if not looked after, the same joint problems developed in the 6-in. rail will be apparent in the 9-in. rail. The renewal of oak ties in improved streets has been a very expensive feature of the maintenance, and has brought about the adoption, to a certain extent, of the steel tie, which, when concreted and held to gage with tie-rods, has given fair results. For this service old rails, cut to the proper length to act as tie-rods, are most useful. As this can be done on the ground it saves the transportation of the old rail to the yards to wait there for the highest price paid for old rail, and in many cases to be moved several times to make room for some improvement or other.

This old rail, of whatever section it may be, can be cut into 8 ft. lengths, turned base up and clamped or bolted to the base of the 9-in. rail. A small tie, 4 ins. x 6 ins. x 6 ft., is used very often to gage and line the track on. The rail tie can be spaced every 8 ft. or 10 ft. with the small 4-in. x 6-in. tie every 10 ft. or 12 ft. A tie-rod is also used in the web of the rail to keep the track to gage. Care should be taken to see that all the four nuts are tight. A space 15 ins. wide and 8 ins. deep should be concreted under each rail, using a good hydraulic cement; the space between the rails should be concreted to suit the kind of pavement to be used, and that between the web and outside of ball and flange should be filled with a clean cement and sand, thus leaving no space for water between the pavement and rail. The joints of this construction are held in place preparatory to welding by a small plate with two bolts, which are taken off when the rail is welded.

Two methods of track welding are in use, the cast weld and the electric weld, both of which are extensively employed. As the life of a rail depends upon the perfection of the joint, great care should be taken in making it. The best possible trackmen should have charge of this part of the construction. The problem of expansion and contraction, while not entirely solved, has by experience become so understood that the breaking of welded joints has been greatly lessened. When welds break some companies cut them out and fit in tight joints. This, if done for several winters, stops the breakage. While the heat of summer does not seem to effect the rail, the writer is, nevertheless, of the opinion that it not only pushes the crossings and special work out of line, but has a tendency to widen the gage. In his own work the writer has lessened these objections by the use of an expansion joint every 300 ft. or 400 ft. As this joint provides for the expansion and contraction it should have exceptional care.

As I have shown that the ordinary fish-plate will not hold up under the heavy load of a modern car, a continuous rail-joint, with expansion holes in the plates, or a construction equally as substantial must be adopted, at least until time and experience develop its weak places and suggests a change. In this as well as other classes of permanent construction care should be taken to obtain the proper lines and established grades of the street, so that when the streets are improved the track will not have to be disturbed.

The next, and one of the most important items in the operation of the road, is the location and class of special work. In the early stages of special work, like that of the main track, light rails were used of the same section that was in the track. This construction was called at that time "built-up work," as the rails were bolted together with angle-bars. The same rails in many cases also answered for curves with a riveted guard; in other cases a guard rail was used. These curve rails were also sometimes of cast iron in 8-ft. lengths; while there was very little trouble in maintaining this class of work under horse-car travel it soon gave place, under electric traction, to heavier rail. The use of the electric cars also soon showed that built-up construction was insufficient in strength for city service. Realizing that bolts must, as far as possible, be taken out of crossings and special work, frogs, switches and mates, manufacturers introduced the guarantee work, which is now very extensively used, and should take the place of all built-up work.

It is bad policy to renew three or four frogs at a time in a piece of special work, to get a few more months' wear out of the balance of the special work. It would be better to endure the bad frogs a little longer, then renew the total work with the best possible hard center work, which is made of 6-in. to 9-in. rail. A mistake has also been made in several cities in welding the main track to the special work, the effect of which was to pull the special work to pieces. Since it has become necessary to discard bolts in crossings and frogs in special work, care should be taken by the manufacturers and those ordering special work to have as few joints as are required in order to make the pieces convenient to handle, and these joints should be provided with some good rail-joint. Care should also be taken to have the best possible work on the combination joints, as in the main line this work must be of the best concrete construction. The unbroken main line cross-overs and special work, which have also been used extensively, have been removed in most cities, not that they are not satisfactory, but they have been objected to by the city administration and the driving public.

In a characteristic track report, made by the writer, of a large system, the word standard presented itself very forcibly. In the early days of street railroading everybody wanted a franchise, and to look back over the different companies that have consolidated into one large system one is tempted to say that it did not require much talent to obtain a franchise. These independent companies, each with their different ideas, have complicated the construction of the ordinary consolidated city road into a "Chinese puzzle." Each road was then small enough in itself to be thoroughly understood by its managers, but when consolidation took place and the records were turned over, little or nothing was known of the track construction, each road having its records in the memories of its track foremen and roadmasters. Some of these men remain in the service, while others find other employment; hence with no records, and with the men with memories gone, little is known about the track, its condition or life until it falls to pieces. The only thing left to do is get all the possible data that can be secured, and make it up into a characteristic report, showing the location and kind of rail, then adopt the best possible 9-in. concrete construction and let "Standard" be the motto. In a few years no records will be needed except as to "when laid." A change of management should not change the class of construction if it is first class; if not, a few additions along the same lines for betterment would not change the general policy.

In the case of cable roads, which are rapidly giving way to electric, great care and study should be given the possibility of conversion into underground electric. The only objection is the distance between the tracks, which in some cities is only 4 ft. This, while wide enough for cable cars, is too narrow for electric, so that in many cases the cable conduits have to be pulled up in consequence.

Leaving the city road now we take up interurban roads. These roads, if worth building at all, are worth building right, as the most important item with a prospective investor is cost of maintenance for a few years. Hence the first cost should be a secondary consideration, and the best possible grades and lines obtained to get high speed. Great care should be taken with drainage, as goodness in a roadbed depends upon how dry it is kept. Steel girder bridges on concrete or stone abutments should be used for large streams and small arch concrete culverts for smaller streams. The track should be laid with 60-lb. to 80-lb. A. S. C. E. T-rail in 60-ft. lengths, with broken and suspended joints on 6-in. x 8-in. x 8-ft. white oak ties. A continuous rail-joint should be employed, and a good steel tieplate on every tie. The wire bond has given way to a concealed bond, not because the former was unsatisfactory, but because it was too handy for the junk dealer. Especial care should be taken in surfacing and lining the track. Rock or river gravel should be used to the depth of 6 ins. to 8 ins., and filled up to the top of the rail in the center of the track and to the top of the tie at the rail lines; this affords not only weight, but gives good drainage. The roadbed should always be graded for double track, and the track laid on one side. When single track is built, all turnouts should be on one side and in place for double track, and the leads to these turnouts should be spring-split switches and spring frogs, giving the main line an open and unbroken track.

Notes on Wheel Wear

The following are some notes in regard to twenty wheels by one maker, taken from the cars of one of our large street railway systems. The wheels were all worn out, and had made a total of 810,000 miles in round numbers. The lowest mileage made by any one wheel in the lot was 17,600 miles. The best wheel made 64,300 miles. The average life was a small fraction over 40,000 miles. Six of the wheels made less than 30,000 miles, and were probably thrown out for bad flats. Eleven wheels made over 40,000 miles, and five wheels went up above 50,000 miles. There were two that exceeded 60,000 miles. Skidding and breakage on bad crossings had much to do with the failure of many of these wheels. Grooved rails, special work, and crossings where wheels have to run on their flanges may be credited with a large share of the broken or chipped flanges.

The percentage of breakage is very uneven. Out of one lot taken off it averaged 7½ per cent, while in another lot from the same road it was 2½ per cent.

It might be said in explanation of this record that the system is of the most extensive in the Eastern States and includes both city, suburban and interurban lines. Both single and double-truck cars are used, but the latter are in the majority. The road has a considerable number of steep grades.

CORRESPONDENCE

Better Cast-Iron Car Wheels

New York, Jan. 18, 1902.

EDITORS STREET RAILWAY JOURNAL:

The opinion prevails among those connected with our larger street railway systems, and especially among those who are using grooved rails, that the limit of the cast-iron wheel has been reached in strength and durability, at least with present weights and sections. There are many facts to support this belief, and for this reason railway men are looking for some new material. Better cast-iron wheels can be made. Most of the scientific manufacturers of the country are ready to produce them, but not at the price per pound of sash weights. Such wheels would also be heavier than those at present employed.

When the railway man asks for a stronger or better wheel, the maker has to reply that the present forms are wrong and that the wheels are too light. The idea of a more durable or stronger wheel for more money does not once come up. The wheel maker knows it would be useless to present such a proposition. The roads want stronger wheels and they would like to have them last longer, but because they are of cast iron, the idea of increasing the price is not to be entertained.

So long as the question of first cost is to govern the wheel question there is little hope for improvement. At least the manufacturers of cast-iron wheels have no incentive to improve their product. Railway men may ask for stronger metal and more durable flanges, but these cannot be had at present prices.

The question may be asked, how much improvement is possible in cast-iron wheels? This is somewhat difficult to answer. There has been a very general increase in durability of wheels during the last half-dozen years. Guarantees have been steadily rising from 25,000 miles to perhaps 40,000 miles, the mileage depending upon the road, the speed, the service, and the skill of the purchasing agent. On some roads in 1895 the average wear of a wheel did not exceed 15,000 miles. The increase in mileage has largely been due to the greater skill and care in the process of manufacture. To make a better wheel to-day will call for a considerably increased cost of metal, and a greater quantity. Some railway whims will have to be abandoned. Men who are fond of falling back on their "experience" will have to allow the wheel maker to do some things they do not approve. And in the end, the new stronger, heavier, and more durable wheel will cost a great deal more money.

That a better wheel is possible is shown by the experience of the steam roads. When the 100,000 lbs. capacity cars were first introduced some roads had trouble with the flanges. It was said that 135,000 lbs., the total load on the eight wheels, was too great for cast iron, and that the heavy cars would require steel wheels. Others having more knowledge of cast iron thought differently. Special wheels were made for some of the roads using these heavy cars, and complaints about broken flanges ceased. Comparing the section of one of these heavy wheels with those of an ordinary eight-wheel street car, there seems to be an enormous difference. But this is not so great when we consider that the load on one set of wheels may be 135,000 lbs., or possibly more, and on the other 25,000 or perhaps 30,000 lbs. The heavy load may run 40 or even 50 miles per hour, while the street car does not often exceed 25.

W. L. WRIGHT.

The Construction of Non-Combustible Cars

JACKSON AND SHARP COMPANY
OPERATED BY AMERICAN CAR AND FOUNDRY COMPANY
Wilmington, Del., Jan. 20, 1902.

EDITORS STREET RAILWAY JOURNAL:

In connection with the question of constructing non-combustible car bodies for motor service for electric traction, probably the remedy here is one for the electrical engineer rather than the car builder to apply. However, there are certainly no very considerable difficulties in making the present type of motor car body less combustible, providing there is not too much regard necessary to the weight of the car.

The question raised seems to be readily divisible into two parts—one, that of rendering a car approximately incombustible under ordinary service conditions, and the other in case of accident. The latter presents the greater difficulty unless, perhaps, the electrical equipment can be so arranged as to be automatically controlled.

For service conditions it would probably be sufficient if the under side of the car bottom is protected.

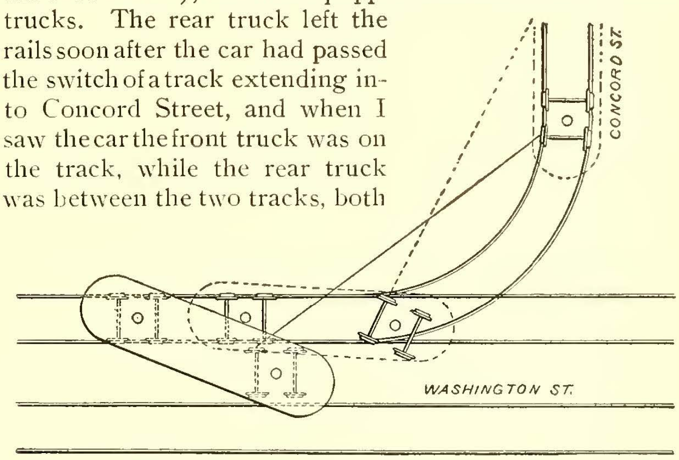
CHARLES S. GAWTHROP.

Replacing a Derailed Car

Brooklyn, N. Y., Jan. 12, 1901.

EDITORS STREET RAILWAY JOURNAL:

I was recently a witness of an ingenious method of replacing a derailed car in this city, and as the method adopted might prove applicable elsewhere, I will describe the plan employed. The car was derailed on Washington Street (see enclosed sketch), and was equipped with maximum traction trucks. The rear truck left the rails soon after the car had passed the switch of a track extending into Concord Street, and when I saw the car the front truck was on the track, while the rear truck was between the two tracks, both



in the position shown by solid lines in the sketch. As will be seen, the front end of the car projected over the up track, stopping traffic on both lines, and as Washington Street is one of the main thoroughfares to the Bridge, a general block of cars on that street was imminent.

Fortunately, the switchman stationed at the corner of Washington and Concord Streets immediately suggested a quick method of putting the car back on the track, which was immediately adopted. A line was connected to the back of the frame of the forward truck, and the other end was attached to the back of a car which was standing on Concord Street. Both cars were started up and the derailed car soon took the position shown as dotted in the sketch. The line was then attached to the forward end of the derailed truck and the front wheels were dragged on to the track. The whole operation took only a few minutes, and while it may not have been particularly beneficial to the wheels of the derailed truck, it avoided a blockade, which was the principal object sought.

J. D. YATES.

STREET RAILWAY JOURNAL

FEBRUARY 1, 1902.

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Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the Journal *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our news columns.

All matters intended for publication in the current issues must be received at our office not later than Wednesday of each week.

Address all communications to

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A correspondent, in a communication published elsewhere in this issue, calls attention to the greater demands made upon car-wheels than five years ago, and the importance of heavier wheels. There is no doubt that with the greater length of our street railway systems, the larger cars which are in use and the more rapid service, the wear of car-wheels is increasing, and the cost of replacing them is becoming an important item in railway management. The actual size of this item of expense is not so much a source of trouble as the fact that it is constantly growing. During the last half-dozen years there have been attempts made along several distinct lines to reduce the expense of replacing wheels. The favorite and apparently the most successful one has been to make closer bargains with the wheel manufacturers. It has not always been possible to obtain a reduction in prices, but by making the terms of the guarantee a little harder, or the mileage a little longer, the result has been attained. More mileage for a given amount of money has been looked upon by street railway managers with a great deal of satisfaction. This has been gratifying to the superintendent, but has hardly cheered the wheel maker. The latter has been pushed about as far as it is possible to go in making good wheels at low prices.

Great variations have taken place in the forms of contracts within the last decade. Once makers guaranteed the mileage of the wheels and allowed the railway company to record, or quite as often to guess, how far the wheels ran. That system lasted a surprisingly long time. In the end it was more than the manufacturer could stand. After that some roads demanded that the wheel maker should replace the wheels which failed to make the guaranteed mileage, and also pay for taking off the old and putting on the new. This was rather too much in favor of the road, especially as the mileage demanded was continually made greater. One of the next forms was that a lot, say 100 wheels, should make a certain number of miles. Then the wheel maker got the advantage of every wheel which made more than the average mileage. He only replaced wheels in case the total mileage of all the wheels was less than the guarantee. The short lives of thirty or forty wheels might be more than made up by the wear of the others. This system gave the man who could make good wheels an opportunity to obtain a reward for his skill. The railway companies were not satisfied with this, and asked to have every wheel come up to the average guaranteed.

This form of contract is equivalent to another cut in prices. The company gets more mileage for its money than before. To illustrate, we may take a case from actual practice. Three or four years ago a road purchased a lot of forty wheels, of which thirty-eight were received and put in service. When the whole lot had been removed it was found that eight of these wheels had made less than the 40,000 miles which had been guaranteed. They had, however, averaged 82½ per cent of the required mileage, falling short 7000 miles each. Under the individual wheel guarantee all of these wheels would have to be replaced, and the road would have been the gainer on the whole lot to the extent of about 264,000 miles. As it was there was no replacement of wheels. The contract called for an average of 40,000 on the whole lot, and as they made about 1,700,000 miles altogether, as against the 1,520,000 which had been guaranteed, it was a very fair proposition for the company. It has not always turned out so favorably for both parties. On another road a lot of twenty wheels at about the same guarantee all fell short. The average mileage was but 24,600. As all the wheels would have to be replaced under the contract, the road was probably a gainer in the mileage by perhaps 80,000 miles. Under the general guarantee, probably thirteen wheels would run long enough to make the required 80,000 miles called for without any surplus. The road would be out, and the wheel maker—well, he would save five poor wheels.

The paper read by Dr. Cary T. Hutchinson at the 160th meeting of the American Institute of Electrical Engineers, and published in abstract elsewhere in this issue, bears the title, "The Relation of Energy and Motive Capacity to Schedule Speed in the Moving of Trains by Electricity." This title is most attractive to the railway engineer and intending reader; it holds out the prospect that in this paper will be found methods and data which will be of assistance in surmounting some of the many difficulties which confront one in attacking problems in heavy electric traction.

Further encouragement to hope for something good and useful is contained in the running title to the paper, "Hutchinson on Electric Railway Operation." At the middle of the first paragraph are references to Fig. 1 and Fig. 2 as illustrating the practical problem of train acceleration. Here the reader meets with the first of the many surprises in this interesting paper, for the author assumes straight line coasting and braking. In rough diagrams of speed curves it is common practice to use straight lines for coasting and braking; still, it is well known to all engineers that these lines, in fact, are not straight. Furthermore, neither in these diagrams nor elsewhere in the preliminary discussion is any account taken of the effect on train resistance of the composition of the train, the changes in gradient and alignment of track, or even of the effect of the inertia of the rotating parts. Again, in the numerous calculations of economic acceleration and equipment, no consideration is given to service requirements, yet service requirements as to schedule speeds, etc, are, in many cases, so important as to become actually controlling factors in the case, for the capacity to make or exceed schedule speeds is the very condition that determines the existence of a road in many cases. The engineer is not usually confronted with the problem of more or less completely determining the kinematics of the movement of a point from rest to rest by a uniform positive and two uniform negative accelerations for respectively uniform periods of time and accomplishing in all cycles uniform distances, and the solutions of such cases, however valuable from an educational standpoint, do not enable the engineer successfully to specify the car or train movement and equipment adapted to perform actual service of certain requirements over an actual track between stations which have been located from other considerations than those of pure kinematics. Two of the final conclusions are certainly of a nature to attract wide attention. The first is that it will be impracticable for the New York Rapid Transit line to maintain its proposed 35-mile per hour schedule speed on 7500 ft. average runs, and 15 second-station stops. The second is that high initial acceleration does not conduce, usually, to economical running.

Some of the numerous tunnel systems which are now being either planned or in course of construction in New York City will demand the production of electric locomotives comparable in power to the strongest steam locomotives. As a general rule, the multiple-unit system is undoubtedly more desirable for use than the electric locomotive for all cases of purely electric traction, but with a mixed system, where it is necessary to haul regular passenger coaches through a tunnel, a standard machine of locomotive type must be produced. The only existing electric locomotives in this country which at all meet this demand are those employed on the Baltimore & Ohio Belt Line at Baltimore, and while it is true that these locomotives are in daily service, their success is only a success of past history, and would not be accepted as at all suitable to cope with the New York problems which are at present under consideration. The Baltimore locomotives were triumphs of engineering in their day, but that day is now nearly seven years past, a very long period in the history of electric traction. That the Baltimore & Ohio machines are wonderfully powerful no one contests, but their system of gearless motors and hand manipulated controllers, and the arrangement of their heavy wiring and parts is such that repairs of any kind are very formidable. Therefore, the question of what improvements must be made in a large electric locomotive, for improvements there must be, is of very great interest. The enormous weight of the heavy motors on the drivers of the locomotives of the Baltimore & Ohio type is not a disadvantage, in fact, on the slimy, slippery rails of the Baltimore tunnel it is necessary to use sand all the way to prevent skidding. The chief trouble lies in the inaccessibility of the gearless motor used and the necessity of dismantling the whole locomotive when a motor is taken to pieces. This condition is so serious that it is almost a certainty that the next large locomotives built for use in this country will contain gears. The ratio of reduction will probably be very small, not over 1.5 to 1. The lesser output per pound of the slow-speed motor is not in this case to be looked upon in the light of a disadvantage, and the greater radiating surface and heat inertia capacity fit it much better for railway work.

Of two motors of equal horse-power, but widely different speeds, the smaller is sure to run the hotter, for with good design the losses of each are not in proportion to their radiating surface, and the larger machine, with its greater ability when overloaded to store up heat in its structure to be radiated at a more convenient time, has features of value in intermittent work which cannot be overlooked. It is not too much to say that a locomotive equipped with high-speed motors would have to carry extra weight in order to have traction in proportion to its power. A locomotive which has a large excess of torque over that necessary to skid the wheels under the best possible tractive conditions that can occur in practice is not worth sacrificing a single feature of advantage to obtain. A locomotive is not like a passenger car, and radically new arrangements of its motors are therefore permissible. It is no longer necessary, for instance, to have the motors underneath the car floor if that should not seem advisable. In fact, it is a question of great importance whether it is not better to have them in an accessible and protected position above the car floor, so that their commutators and bearings can receive the same careful care that is afforded to railway generators of like capacity. Sheltered from mud and dust and in full view of the motorman, they can be a most open type of design, thereby rapidly radiating any heat which they may acquire and be easily accessible at all times for cleaning. Under constant inspection in this way troubles that occur will be anticipated and prevented, and the disabling of a large locomotive is a so much more serious matter than the disabling of an ordinary street car, that this consideration should weigh very heavily in the design of a new machine. The system of control will undoubtedly be one of the master type. The heavy contacts necessary in a large locomotive when employed on a hand controller cannot be operated with the necessary promptitude and precision, even when manipulated by an athlete of no mean ability. The location of the sub-controller can then be placed with reference to convenience of wiring and repair only, and need not be located at the engineer's station. It is safe to say that when the heavy electric locomotive has been as thoroughly standardized as has the lesser electric railway work, it will be a considerably different structure from any electric tractor now in use.

Alleged Dangers in Electric Traction

The discussion on the subject of non-combustible cars for electric traction, started by Mr. Westinghouse's letter in the New York *Times*, and with which our readers are familiar through its republication in these columns, continues in the metropolitan press with unabated vigor. The subject is such an important one, and bearing so closely as it does on the practical value of electricity as a motive power compared with steam, we feel the further communications published elsewhere in this issue on the subject will be of interest.

The points in Mr. Westinghouse's communication which we think specially worthy of attention are the indubitable facts that accidents of a serious character have occurred on electric trains, and that they are exposed like other trains to a chance of destruction by fire. These are facts that no one is disposed to dispute. Steam railroads have, through bitter experience, for the most part given up the practice of fast running on a single track without safety precautions. That some electric lines have not learned this lesson is no argument against electric traction. So far as we know, however, no recorded collision of electrically driven cars has caused a conflagration, which is an ordinary result of collisions between steam driven trains. We feel quite justified in concluding, therefore, that electric traction is, upon the whole, singularly effective in lessening the fire risk. In case of heavy electrical trains taking current from an unprotected third rail in close proximity to the track rails, the chance of starting a blaze is perhaps greater than in a trolley system, but here, as elsewhere, good construction averts danger so that we feel thoroughly convinced that in the present state of the art electric trains are uniformly in far less danger from fire than are steam trains. That the use of non-combustible cars would minimize what danger there is seems altogether probable, but where there is one good reason for using such cars on electric trains, there are several times that number for using them on steam trains.

We do not conceive that the question of multiple-unit trains versus locomotives has any substantial part in this controversy. The wiring of a multiple-unit train can be made practically safe, and we have yet to hear of fire on such a train due to defective wiring. On the other hand, a London "underground tube" locomotive was destroyed the other day.

This whole discussion, however, is quite aside from the main issue—the superior safety of electric traction in such cases as the Park Avenue tunnel. This superiority is due to two distinct causes, either of them entirely adequate to justify the public in forbidding the further use of steam in that tunnel for all future time. First, the electric motor gives out neither poisonous fumes nor noxious smoke that obliterates danger signals. The condition of affairs in that tunnel has long been notorious, and has been going from bad to worse for years. There are times when a signal could not be seen two yards for the smoke, and the wonder is that the recent horror has not been duplicated every month for ten years. That it has not been reflects infinite credit on the man at the throttle. Merely for the comfort and health of the passengers the smoke nuisance should long ago have been abolished, even if such a step were not demanded by considerations of safety.

Second, the use of electric traction gives an opportunity for the use of the most complete and perfect automatic safety devices, in addition to the ordinary signals. As readers of these columns know, the system in use on the Boston Elevated is such that even should the operator of the car suddenly become disabled the train would be brought to a stop at the next closed block. With electric traction a block signal system has the motive power directly under its control, and neither failure of the motorman to heed a danger signal, nor failure of the brakes to work, need be an adequate excuse for a collision.

Above Manhattan Island there lies a splendid country, which has long been anathema from lack of rapid transit facilities. Viewed from the Palisades it seems a region fitted by nature to give New York the fairest suburbs in the world. But to the average New Yorker it is almost an unknown land. He is long-suffering beyond all measure in his tolerance of suburban transit facilities, but he draws the line at the tunnel. New York has grown across both rivers faster than it has grown across Spuyten Duyvel Creek. Ferries have no terrors for the commuter; he finds balm in New Jersey, and solace on Long Island; but go northward in the present condition of things he will not.

The first great step toward the future growth of the metropolis is to give it modern rapid transit facilities up along the Hudson. In abolishing the use of steam locomotives in the tunnel, the logical move is the establishment of a fast electric suburban service. This means that suburban trains would come through the tunnel with their own motors, so that there would be no need of a great force of electric switching engines. The multiple-unit system, as we have more than once pointed out, gives wonderful facilities for such service, enabling through cars to be run to diverse and distant points. The whole system of distribution should be laid out with such a development in view, so that the rapid transit of the metropolis could be co-ordinated into a consistent whole. Very little is gained by half doing things, and any move less sweeping in its significance than this will mean work to be undone in the not distant future.

While the plans of the company have not been made public we think that the whole matter will be treated, not in a small and partial way, but along big, broad lines that will lead to the greatest developments in electric traction that our country has yet seen.

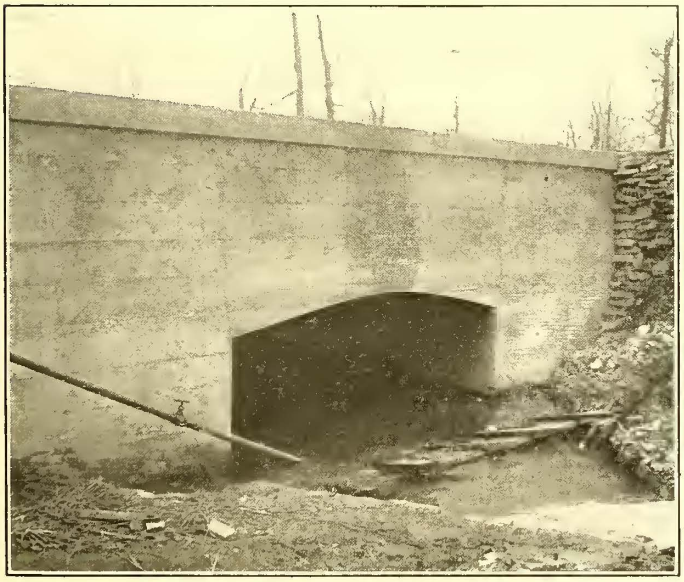
As to dangers peculiar to electric traction, or attending it in unusual degree, we attach little importance to them. The sole inherent danger is that of shock from the working conductors, which, with suitable precautions, may be rendered negligible. As to the rest, the careful and thorough construction that is necessary in any great and well ordered public enterprise will insure a freedom from danger quite complete as can ever be attained on a steam road. In addition, electric traction lends itself, as we have already pointed out, with remarkable facility to the application of safety devices. Non-combustible cars, which have been the innocent cause of so extended a discussion, must be regarded as a useful contribution to general railway practice irrespective of motive power. The enterprise of Mr. Yerkes will bring them into use in London on so large a scale that their future can be trusted to take care of itself.

Construction Work on the Aurora, Elgin & Chicago Railway

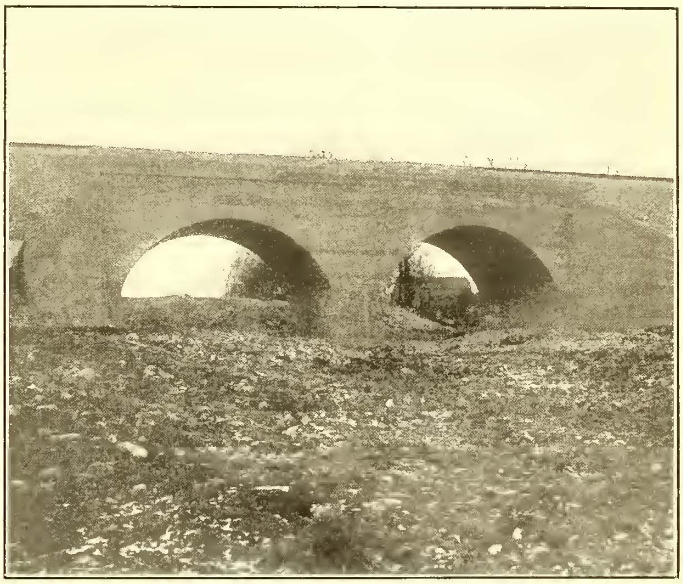
The Aurora, Elgin & Chicago Railway, when completed, will probably afford the best example of heavy high-speed electric railway work to be found in the world. This road is being constructed from the Fifty-Second Avenue terminus of the Metropolitan West Side Elevated Railway in the western edge of Chicago to Wheaton, and from there one branch runs southwest to Aurora, and the other branch northeast to Elgin. From Fifty-Second Avenue to Elmhurst the line very nearly parallels the Chicago Great Western Railroad, and through Lombard, Glen Ellyn and Wheaton parallels the Chicago & Northwestern Railway. The territory through which this line passes is an excellent one for suburban travel. Between Chicago and Wheaton the Chicago & Northwestern Railway gives the principal service at the present time. Between Wheaton, which is the county seat of Du Page County, and Aurora there is at present no direct line, though the Chicago & Northwestern Railway has an indirect line by way of Geneva. The accompanying map, showing the lines of the Aurora, Elgin & Chicago Railway under construction, and the territory through which it passes, will aid to an understanding of the situation. Between Wheaton and Elgin and Wheaton and Aurora the country is without any large villages, though it is a thickly settled and productive farming country all the way. The syndicate controlling this company has also acquired control of the electric lines connecting Aurora, Batavia, Geneva, St. Charles, Elgin and Carpentersville.

The chief interest in the road to the electric railway engineer, however, aside from the local situation, is the solidity of the construction, and the high speed at which it is expected to operate trains in suburban service. In his statement before the New York State Railroad Commissioners at the time of the New York & Portchester Railway hearing W. B. Potter, chief engineer of the General Electric Company, made the statement that the Aurora, Elgin & Chicago schedule speed was to be 40 miles per hour, including stops, with the stations 3 miles apart, the cars weighing 40 tons, and this with a maximum speed of 65 miles per hour. This gives a general idea of the schedule which will probably be maintained when the road is completed. Of course, as a matter of fact, the location of stopping places will vary considerably from the figure given. In some places, as, for example, between Wheaton and Elgin, long runs can be made at maximum speed. The motor equipment is designed and guaranteed to maintain a car at a maximum speed of 70 miles per hour on the level at normal voltage on the third rail. To insure this high speed the motor equipment will be very heavy, indeed the heaviest yet put on cars for this class of service. Each car will have four 125-hp General Electric motors. The cars and trucks will follow M. C. B. standards quite closely. The General Electric multiple-unit or train-control system is to be put on all the cars. It is the intention to run cars either singly or in trains. In case trains are made up consisting of as many as three cars, one of these cars will have no motors, otherwise every axle on the train will have a motor.

MASONRY AND STEEL BRIDGE—AURORA, ELGIN & CHICAGO RAILWAY

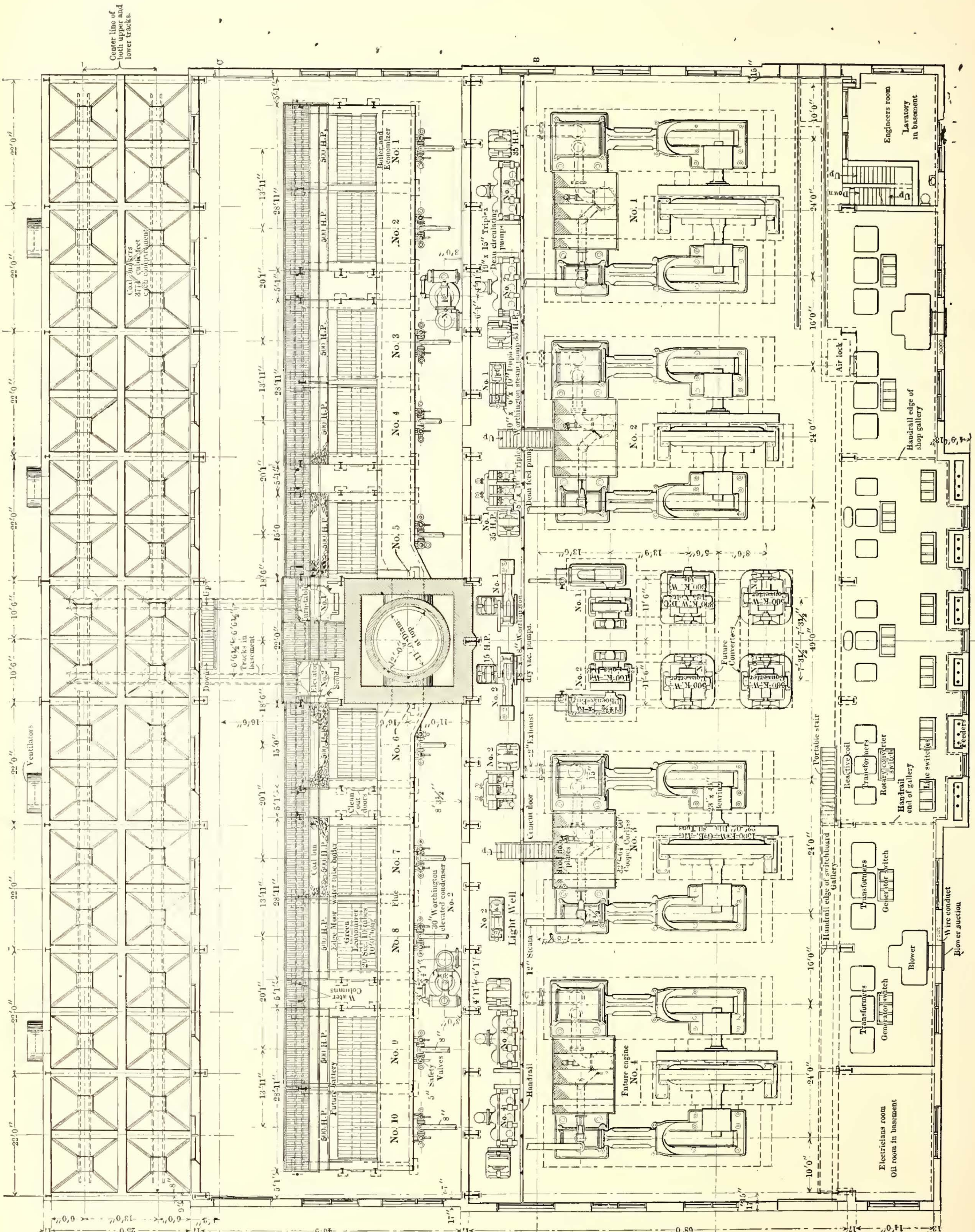


SOLID MASONRY BRIDGE



15-FT MASONRY ARCH AND FILL

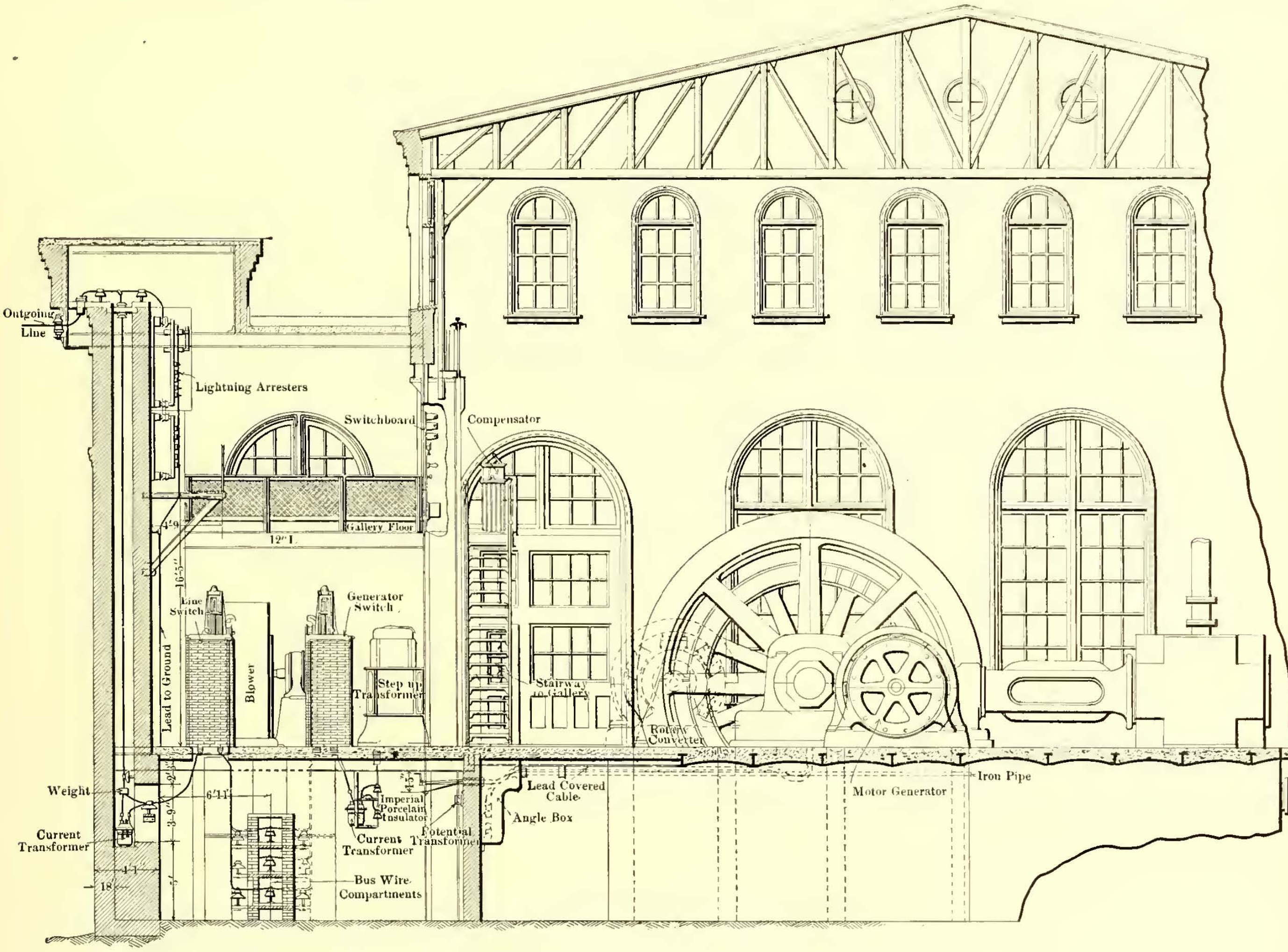
The track construction which is now going on is of the most thorough character and leaves little doubt as to the practicability of attaining the high maximum speed contemplated. The culverts and bridges are of a solidity which savors strongly of English steam railroad construction, as can be seen from the views of construction work is to be double-tracked. From Wheaton to Elgin and to Aurora single-track lines are being built. However, on the single track the sidings are of considerable length, to



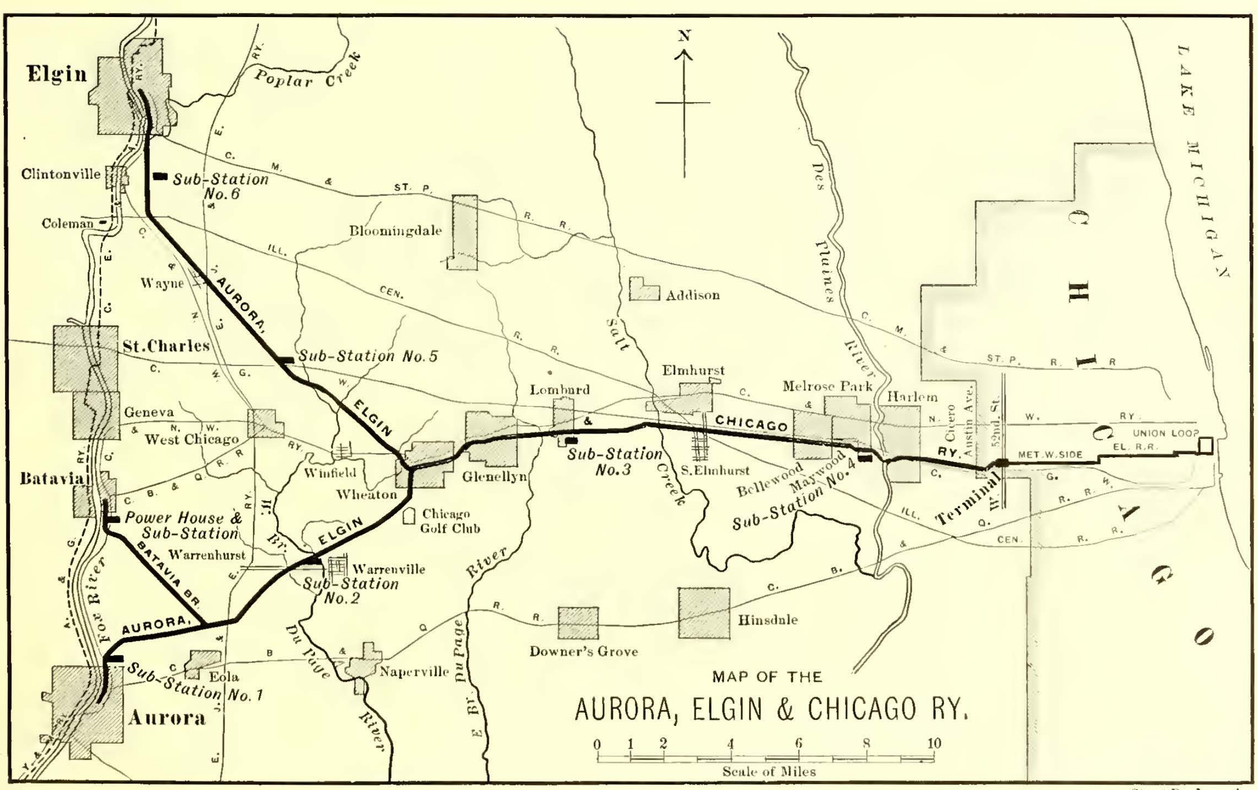
PLAN OF POWER STATION—AURORA, ELGIN & CHICAGO RAILWAY

accompanying this article. Wherever possible the highway has been carried over or under the road, and in doing this no makeshift construction has been employed, as the engravings testify. From Chicago to Wheaton the line avoid loss of time at the passing points. For example, between Wheaton and Aurora there are about 2 miles of siding. The line is ballasted and graded throughout after the best steam road construction. In some places very deep cuts and high fills have been necessary. The track rails are 80 lbs. to the yard in 60-ft. lengths.

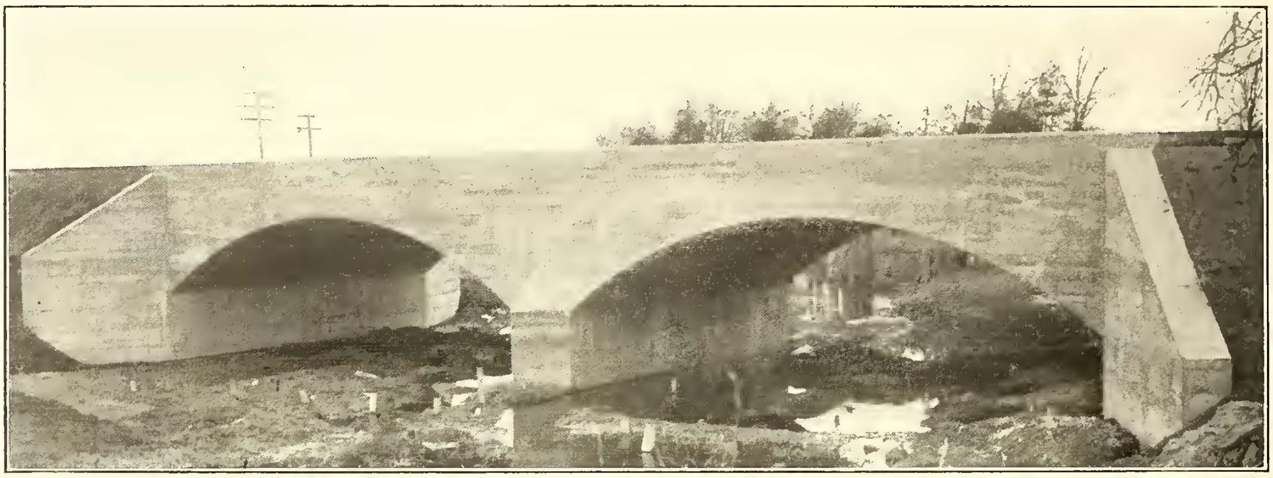
The road is to use the third rail, except in the towns of Elgin and Aurora, where it does not run over a private right of way. The third rail is to be 100 lbs. to the yard, located in the standard position outside of the track rails, as adopted by the elevated roads of Chicago and other cities. The conductivity afforded by this 100-lb. section of T-rail will be sufficient so that no copper direct-current feeders will be necessary. The power is to be transmitted



CROSS SECTION OF POWER STATION



MAP SHOWING ROUTE OF AURORA, ELGIN & CHICAGO RAILWAY at 26,000 volts over three-phase lines supplying sub-stations, located as shown on the map. All these sub-stations will feed direct into the third rail, which will not be normally sectioned, but will be all tied together, so that the sub-stations will assist each other. The power house is being built at Batavia on the Fox River, as indicated on the map. The plan of this power house is shown herewith. At first three of the 1500-kw units will be installed. From the power house three three-phase, 26,000-volt aluminum feed lines will be run out. The arrangement will be such as to give duplicate feed lines to most of the road. One line will run directly from the power house to sub-station 1, at Aurora. From there to sub-station 2, at Warrenville, and then to sub-stations 3 and 4 on the main line. Another line will run directly from the power house to the Warrenville sub-station, where it will join the high-tension line from Aurora. Another high-tension line running direct from the power house to sub-station 5 will also run northwest to feed sub-station 6, and will be continued east to sub-stations 3 and 4. Sub-stations 3 and 4 will, therefore, be supplied from two high-tension lines, one of which comes from the power house by way of sub-station 5 and one by way of sub-station 2. The high-tension lines, therefore, practically form two loops, so that in case of a break anywhere on the high-tension lines current can be supplied from the other direction, except in case of sub-station 6, which for the present will have only one source of supply. The high-tension lines are to be run on poles 35 ft. to 40 ft. in the country, and 50 ft. to 60 ft. in the towns through which the road passes.

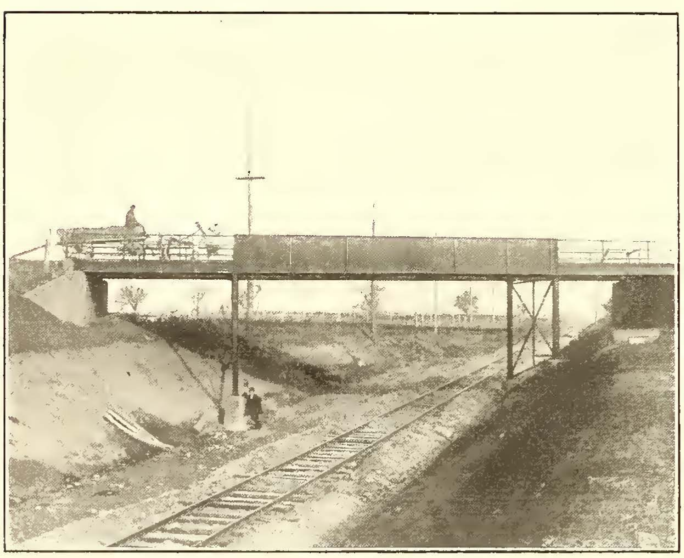


35-FT MASONRY ARCHES

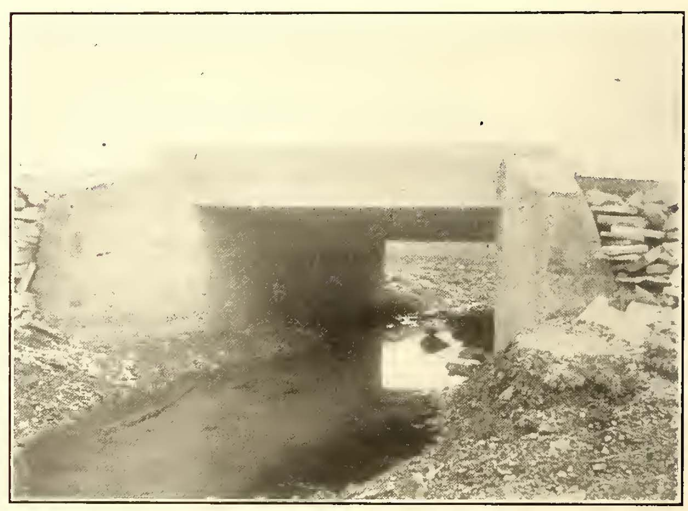
The cars are being built by the Kuhlman Company, of Cleveland, and the Niles Car & Manufacturing Company, of Niles, Ohio, and will be finished in steam railroad style.

A telephone despatching system is to be used, and the sub-station's attendants will receive messages from the despatcher and deliver them to the train crews. This is similar to the system used on the Albany & Hudson Railway. Ernest Gonzenbach, formerly of the Albany & Hudson Railway, is electrical engineer of the Aurora, Elgin & Chicago Railway. Charles Jones is chief engineer of the road, and to him is due much of the credit for the substantial engineering which is to be seen everywhere along the line.

The road is being built by what is popularly known as the Mandelbaum syndicate, of Cleveland, the officers being as follows: President B. Mahler, Cleveland; vice-president, L. J. Wolf, Cleveland; second vice-president, Will Christy, Cleveland; treasurer, M. J. Mandelbaum, Cleveland; secretary, Edward Dickinson, Chicago; manager, F. B. Bicknell, Chicago.



CUT AND HIGHWAY VIADUCT



MASONRY AND STEEL CULVERT

A disastrous explosion of dynamite, used in the construction of the Rapid Transit Tunnel in New York, occurred on Jan. 27 at the corner of Forty-first Street and Park Avenue. Five persons were killed and a number were injured. The responsibility for the accident is under investigation by the authorities.

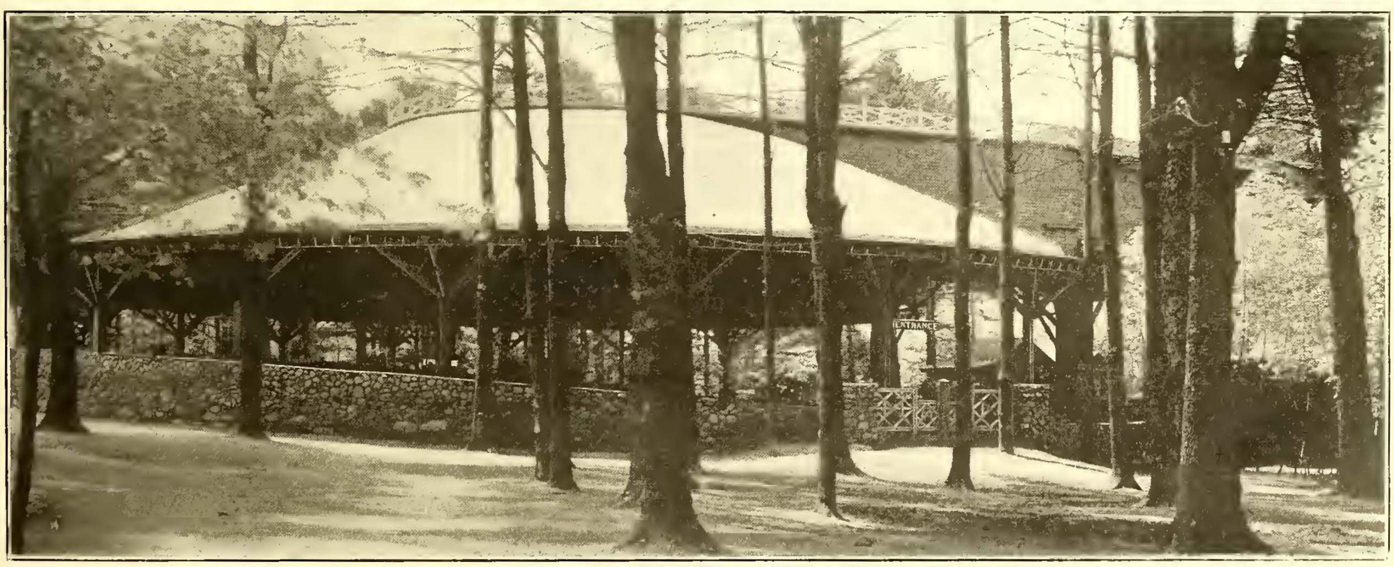
An Attractive New England Street Railway Park

BY H. S. KNOWLTON

Among the methods of creating street railway traffic which have found favor with operating companies recently few have become more specialized than the development of the park business. From small picnic grounds, equipped with a few rickety and straggling seats in shady nooks on the shores of quiet ponds, the modern street railway parks have been evolved, with their numerous devices for recreation and amusement.

For a long time the net value of these parks was a debatable question; it was well known that they created a considerable traffic, but many managers considered that the expense of their maintenance more than counterbalanced the benefit secured from them in the direction of net receipts. Whatever may be the facts of the case in particular instances, there seems to be now no doubt that certainly for the majority of roads the street railway park has been accepted as an important factor in the development of business, and one which cannot be neglected if the full earning power of the property is to be secured.

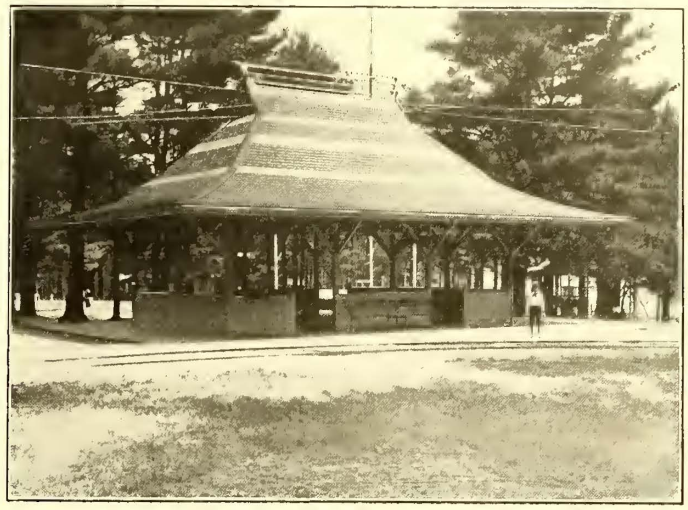
In some respects it may be said that the New England roads were in a particularly good position to establish and maintain park properties. In the first place, being in the older and more prosperous part of the country the leisure class is undoubtedly larger, hence the patronage given to parks is greater than it might be in other sections of the country. Again the fact of the density of the population permits of the establishment of a park within easy riding distance of a large number of people, so that as a usual thing a park has not only one large city, but several to draw from, as well as many smaller communities.



VIEW OF THEATER

One of the most noted of these parks is located at Whalom Lake, Mass., about 3¼ miles from Fitchburg, in the northern part of Worcester County. The city of Fitchburg has a population of about 33,000, and is in close proximity to the towns of Leominster, Shirley, Ayer, Lunenburg and Lancaster, while the cities of Worcester and Clinton, aggregating perhaps 150,000 people, are within easy access. To satisfy a demand in a territory where public parks and amusement resorts were scarce, the Fitchburg & Leominster Street Railway Company purchased in 1893, or thereabouts, a tract of land of great natural beauty on the shores of Whalom Lake and developed it immediately. Its success was instant, and under careful management and by liberal policy it has grown to be a resort of the most noteworthy character. In the season of 1901, the expenses of operating the park were about $3,000 in excess of the receipts, but the passenger fares resulting therefrom amounted to $35,000.

The park now comprises over 60 acres, mostly wooded land upon the lake shore. The lake is spring fed, is surrounded by heavy groves, partly by open fields, and on its

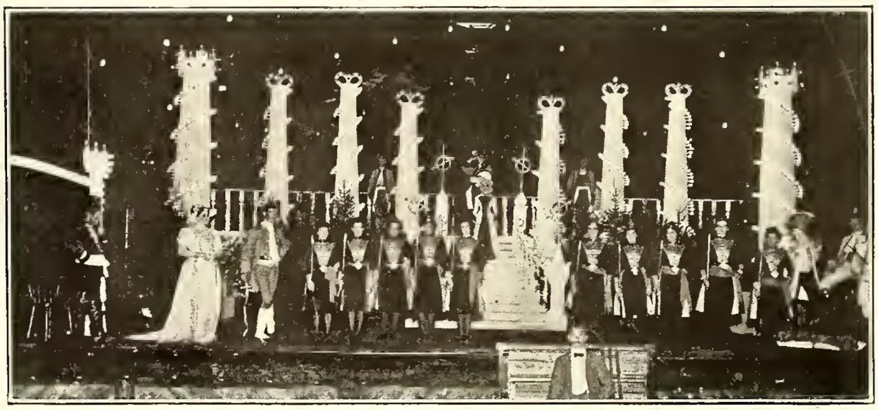


PARK RAILWAY STATION

banks are many charming summer cottages. In the distance the Wanoosnocs and Wachusett Mountain are visible as a background. The lake itself covers about 94 acres. The running time from Depot Square, Fitchburg, to the park is about fifteen minutes, over a line which is soon to be entirely double tracked. The approach to the park is on a gradual slope, the car passing into its domains amid a fine grove of giant pines standing in very thick clusters, bordered by white birches. In the center is a large open lawn, with numerous walks and flower beds, provided with cannas, perennial phlox, coleus and other bedding plants. An attractive bandstand is located between the lawn and the lake. This is always available for bands or orchestras which may accompany picnics.

The electric railway station is a neat building located on the loop track, which all cars traverse in passing through the park, and is built of hard pine, with a finely shingled roof overhanging the platform. In rainy weather, cars may be boarded with the minimum discomfort, while the place makes a capital shelter. The roof is suggestive of Swiss architecture, and is supported by ten vertical posts, into which are built a simple closed fence, which serves as a backing for long seats inside the enclosure. Two cars can be loaded simultaneously and with ease from the platform, which is on the track level. There are four openings into the station. The building is entirely open to the air, reminding one of a kind of rectangular umbrella. A neat flagpole surmounts the roof, and additional settees are provided without the enclosure.

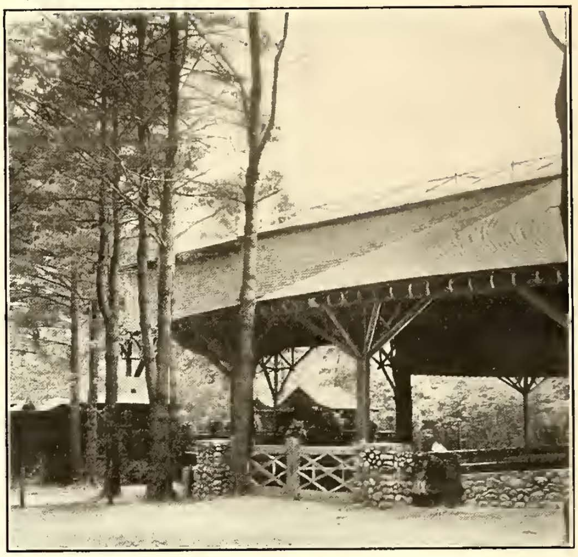
Fronting the lake and back of the lawn among the pines is the "Whalom Inn," a combined assembly hall and café. The former is always available for reunions, entertainments, concerts or dances, without extra expense to the patrons. While no accommodations for other than transient daily patrons are provided at the inn, there is a caterer constantly in charge, who furnishes single meals or elaborate party dinners upon reasonable notice. The sale of intoxicants is strictly prohibited in and about the company's property. The inn has two stories, a private dining-room, flat roof and excellent piazzas, the upper portion being supported by graceful pillars. In the rear of the inn is a bowling alley, in a separate building, also billiard and pool tables, a shuffle board and a shooting gallery. Ample room is provided for spectators, and an elevated platform is located at the front end, where ladies and children can watch the games. The upper floor of this building is divided into parlors and waiting-room. On another side of the lawn is a photograph gallery, where tintypes are made by electric light. A large dancing pavilion is situated near the inn, where a fee of five cents is charged for each set of dances.



SCENE IN THE "GRAND DUCHESS"

Near the station is a small emergency building supplied with a cot bed, long-distance telephone, bicycle checking racks, etc. No bicycle riding is allowed in the main grove, and teams are kept strictly out of the park, though ample facility is provided for tying horses in shady places.

Beyond the grove is a large area of wooded land and some open tracts laid out with roads and walks. Rustic shelters occur at frequent intervals where small parties may picnic in retirement. In the center of this area is a deer park, which is the wildest glen at Whalom. The enclosure is surrounded by a walk and crossed by a neat and effective foot and carriage bridge, designed by W. W. Sargent, superintendent of the Fitchburg & Leominster Street Railway Company, to whose untiring energy and enthusiastic perseverance much of the success of the park is due. The bridge is constructed of rough logs with the natural bark left untouched, and its substantial appearance is most pleasing. Four semi-circular bays, fitted with wooden seats, an excellent plank flooring and conically rounded post tops compose the striking feature of the bridge, which is backed by a superb mass of pine forest trees. Here are kept red deer, elk, a moose, bear, rabbits, pheasants, etc. Swings free to all are found throughout the grove, as well as picnic tables and rustic seats. Numerous church picnics from the towns within a radius of thirty miles are held here yearly. An information bureau is available at the emergency station, which is the company's branch office on the grounds. Special excursions to Whalom Lake are run on Saturdays in the summer time by the Boston & Maine Railroad. The season opens about May 30 and closes about Labor Day.



CORNER OF THEATER

SCENE IN "RIP VAN WINKLE"

On the lake shore is a large boathouse finely equipped with canoes, adirondacks, small and large rowboats. An attractive little steamer makes periodical trips about the lake, starting at the boathouse wharf, which extends well out into the water away from the canoe wharf. The boathouse is divided into a main shed and a two-story office and house, having remarkably spacious doors and windows. The steamer is a new, commodious and well-kept launch, always run by experienced men. The park water supply is taken from a water tank behind the restaurant, after being pumped there from the springy lake by an electric force pump in the boathouse. A Y. M. C. A. boathouse, two-storied, with a diving trestle at one side, is also located on the lake front.

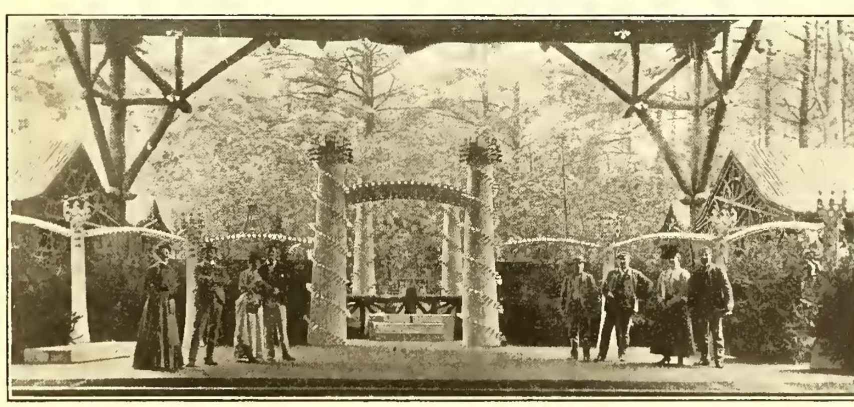
VIEW IN DEER PARK

At anchor just off the boathouse pier is the famous crusier, "McKinley," so widely noticed when, as a trolley gunboat, she was propelled through the streets of Fitchburg in the Presidential campaign of 1896. At night she is briliantly lighted by various colored electric lamps, and near her is a raft from which fireworks are set off on special occasions, like the Fourth of July. With its double turrets, stacks and white, armored-looking sides, the "cruiser" adds a picturesque feature to the lake front.

Just beyond the grove, in a deep bend, is a sandy, rockless beach, where a large bathhouse has been erected. Its most striking feature is a steep toboggan slide, 40 ft. in extreme height above the water, where the more venturesome bathers may descend with the swiftness of a train to the inviting waters of the lake, strike with a tremendous splash and ride nearly 100 ft. over the surface before stopping. The building is 140 feet long and contains seventy rooms, besides a laundry, which is well equipped with quick drying machinery for suits and towels.

Probably the chief interest of Whalom Park lies in its magnificent open-air theater, completed in its enlarged form in the spring of 1901. From original entertainments in the line of fireworks, balloon ascensions and dog shows, the company has developed a theatrical business which earned $10,000 in twelve weeks of 1901, based on productions of light operas by a troupe of thirty people, on one of the best appointed outdoor stages in New England. Last season the operas given were: "Said Pasha," "Heart and Hand," "Boccaccio,""Maritana,""Girofle-Girofla," "Little Duke," "Rip Van Winkle," "Three Black Cloaks," "Fatinitza," "La Grande Duchess," "Claude Duval," and "Olivette." Admission is five cents, with five cents additional for a reserved seat. The theater has a seating capacity of 3060, of which 1600 are reserved, and 1460 unreserved seats. No orchestra is used, the score being played on a piano by the musical director. Auditorium and stage are open to the air, but are covered with a magnificent rustic roof, supported by pillars on its circumference, and two posts in the theater proper. The auditorium is 144 feet in diameter, 42 feet high to the center of the roof, and has a floor made part of cement and part of wood. There are only these two posts in the entire auditorium. They are 80 ft. from the stage. The visual and acoustic effects are superb. The stage is 50 ft. x 45 ft., with dressing-room cabins of ample size on either side, while the background is made up naturally by a beautiful forest of pines. The lighting effects are produced by diffused light, and by skilfully arranged lens lights, usually arcs. Incandescent and arc lamps are found in the grove, and one of the handsomest illuminations ever produced was effected by the use of about 3000 Chinese lanterns hung from the pines.

RUSTIC BRIDGE



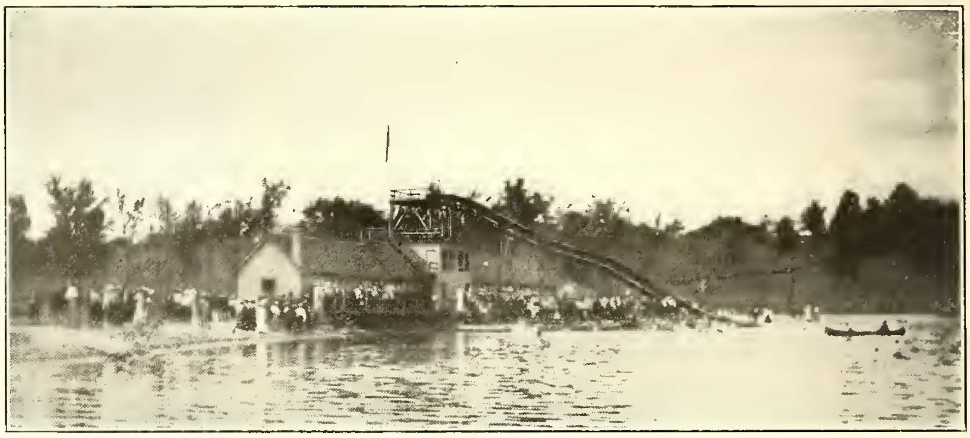
SCENE IN "SAID PASHA"

The theater cost about $20,000, the wiring $3,000 and the concrete flooring $1,000. The performances begin at 3 p. m. and 8 p. m., and tickets for all regular attractions may be secured at the box office four days in advance. No smoking is permitted in the reserved seat section. Each entertainment lasts from one and one-half to two hours. There is an entire change of attraction every week, or oftener, and sometimes the programme is changed daily.

The greatest care is observed by the management to secure performances that shall not offend the most fastidious taste. Ladies are expected to remove their hats, and patrons may be called during acts just as in any city theater.

Merry-go-rounds and all attractions producing noise have been eliminated from the park. The theater roof offers thorough protection from the elements. The theater lighting proper is done by 800 incandescent lamps and 6 arcs controlled by a switchboard in one of the dressing-room cabins, where the manager has complete oversight of every detail of the performance. At times 3800 incandescent lamps have been used on the stage for decorative purposes, and the operatic scenery produced has been most effective. It would be difficult to find more elaborate fittings in an out-door theater. The outside of the theater is surrounded by a handsome stone wall. Electric call bells and push-button circuits are placed wherever necessary. Mailing cards, with plenty of room for correspondence, bearing a fine cut of the new theater, are given away at the ticket offices in Whalom, Fitchburg or Leominster. A small paper, called the "Whalom Breeze," is published by the company weekly during the season, and it contains views of the park, programmes of the operas, concerts, etc., time-tables of the cars, and miscellaneous information about the progress of the park attractions, coming events, etc. It is an attractive little publication, superior in tone and makeup to the average city theater programme.

The inn is under leased operation to W. E. Wood, whose success with the railway restaurants at Greenfield, North Adams, Troy, etc., have made him widely known. The theater is operated by the street railway company, under direction of Superintendent Sargent, and the immediate personal supervision of Mr. Edgar La Nyon, manager of the Cuming's Theater, Fitchburg, who has had broad and varied experience as a theatrical manager throughout the United States. Mr. La Nyon is planning an ice palace and winter carnival for the winter of 1902-3. At present the company clears a large space on Whalom Lake for skating parties, and keeps an employee constantly on duty at the emergency station. The traffic is very heavy in the summer time, often ten or twelve cars leaving the park in close order. All cars are fitted with red-colored oil lamps on the rear vestibule, as a precaution against accident, in case the current is cut off. Rear-end collisions are thus reduced in possibility to a minimum. The motor equipment is composed mostly of two Westinghouse 38's per car. Fifty-eight motor cars with double equipment are operated by the company, which owns about 25 miles of track, built of 60-lb. and 90-lb. girder and T-rail; maximum grade, 7.3 per cent. The power station is located in Fitchburg and has 1200 kw in Westinghouse generators, 1310 hp. in Westinghouse engines, and 1200 hp in Dillon boilers. The officers of the company are: President, H. A. Willis; vice-president, H. I. Wallace; secretary, C. T. Baker; treasurer, R. N. Wallis; auditor, E. Parker, and purchasing agent and superintendent, Wesley W. Sargent.



BATHING PAVILION

TERMINAL STATION AT PARK

Mr. Sargent, the superintendent of the Fitchburg & Leominster, has had twenty-two years' practical experience in street railway work, having begun his career in 1880 with the Lynn & Boston on its Chelsea division. He was appointed to his present position in 1886, and is well known in the country for his originality and energy in planning and operating Whalom Park, in addition to the routine duties imposed by the regular railway service.

Recent Work of the Ohio Central Traction Co.

The Ohio Central Traction Company, control of which was secured by the Pomeroy-Mandelbaum syndicate about Nov. 1, has since that time completed its Crestline extension, and the road was put in operation on Christmas Day. W. E. Haycox, who was general manager of the road with the original owners, has been retained in that capacity by the syndicate. The road runs on a private right of way for nearly its entire length. The company is grading on the Mansfield extension from Crestline with a large force of teams, and if the weather continues fine this work will be completed by the middle of March. This part of the line will run over a private right of way from Mansfield to Crestline, and is almost an air line. Cars will probably be in operation to Mansfield by June 1 at the latest, which will give the company a run of 30 miles from Bucyrus, through Galion and Crestline to Mansfield, which distance will be covered in less than one hour and thirty minutes. The company's new cars are being built by the St. Louis Car Company. They are nearly 50 ft. long, are equipped with high-speed trucks of the St. Louis make, M. C. B. type, and are equipped with four 50-hp Lorain Steel motors.

Engagement of Employees in Birmingham

The system of engaging employees followed by the Birmingham Railway, Light & Power Company, of Birmingham, Ala., is very complete, and as a result the class of men employed on the system is of a very high grade. Through the courtesy of J. B. McClary, manager of the railway department of the company, several of the blanks required in the examination of conductors and motormen are presented herewith. Their method of use is as follows:

The applicant is first interviewed by the manager, and if the latter is favorably impressed by his appearance and there is an opening for his services on the line, he is given a blank application for employment and an application for bond, as all motormen and conductors are under a bond for $500 for the faithful execution of their services. This bond is taken out with one of the security companies. The application blank is given below, and is on a single sheet of paper, with notations for filing as indicated. He is then sent with a letter to tne company surgeon, who is requested to give the applicant a physical examination. This examination is somewhat similar to the one in use by the United States Army. If he successfully passes this examination and the blanks filled out prove him to be desirable for an employee, he is given a letter to the despatcher of the division to which he is assigned, requesting that he be trained for a motorman or a conductor.

The active work of the new employee then begins. He is first put on to practice with an experienced man for twelve days, after which he is examined on the rule book and bulletin orders pertaining to the division on which he has been training. If he successfully passed this oral examination he is sent to the office of the manager and is obliged to pass a written examination on the duties of his new position. These questions are printed in small books, which contain 142 questions for motormen and 123 questions for conductors, covering all the general rules, bulletin orders and the handling of a car. The applicant is then subjected to an oral examination by the superintendent of traffic. He is given a rating on a percentage basis for all of the examinations (as indicated in the "Note" published at the end of the question sheet), and from the average thus obtained he is given a relative "rating," as comparated with other applicants. If this rating is satisfactory, that is, if he is successful in passing the several applications, he is accepted as an employee, has a badge issued to him, and takes his place on the extra list, whence he gradually works his way up to a regular employee.

All applicants must be over 21 and under 40 years of age, 5 ft. 8½ inches high, and must be able to see ½-in. letters a distance of 10 feet. They must be able to hear a watch tick with either ear at arm's length. Their heart, lungs, liver and kidneys must be sound, and they must show a satisfactory vaccination scar. Applicants will not be accepted, also, who have a rupture or any deformity.

The application for employment, which the employee has to fill out and sign first, is given below:

APPLICATION FOR EMPLOYMENT.

(To Accompany Application for Fidelity Bond.)

Requirements.

Applicants are required to pass a satisfactory examination in the following:

Reading, writing, arithmetic, map of the city of Birmingham, rules and regulations of the company, city ordinances referring to the department entered, all report forms used in the branch of the department entered, a practical knowledge of the operation of cars or other appliances to be used.

The physical requirements as passed upon by the company's surgeon are as follows:

1. Age, twenty-one years to forty. 2. Standard height, 5 ft. 8 ins.; minimum height accepted, over 5 ft. 4½ ins. 3. Ability to see, with each eye, ½-in. letters at a distance of 10 ft.

Note.—Applicants will not be accepted who have a rupture or any deformity. Applicants must show a satisfactory vaccination scar.

Birmingham, Ala., 190

BIRMINGHAM RAILWAY, LIGHT & POWER CO.,

Gentlemen:—I hereby apply for a situation as , and if accepted, agree to faithfully observe all rules, regulations and instruction, to perform my work to the best of my ability, waiving all claims for damages by reason of any injury I may receive while in the service of this company.

1. Full name
2. Address
3. How long have you resided in Birmingham?
4. How many places of residence have you had in the last three years?
5. Nationality
6. Where were you born?
7. If foreign born, how long since you were naturalized?
8. Married or single.
9. Is your wife living or boarding with you?
10. At what age did you leave school?
11. My age is years.
12. Height feet inches.
13. Weight pounds.
14. General health
15. Are both your eyes in perfect condition?
16. Is your hearing perfect in both ears?
17. Who is depending upon you for support?
18. Color of your eyes
19. Color of your hair
20. Have you a trade?
21. In the following blanks state how you have been occupied during the past ten years, whether employed or not:

From		To		In the Service of [Name of Employer or Corporation]	As [Nature of Position or Occupation]	At [Place Where Employed or Located]	Under [Name and Present Address of Manager or Supt.]	Why Did You Leave?
M'nth	Year	M'nth	Year					
......	18...	......	18...	....	....	....	....	....
......	18...	......	18...	....	....	....	....	....
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I have had in all year's experience in the railway business.

22. How long have you been out of employment?
23. Reasons for leaving last situation
24. Family resides at
25. Is your life insured?
26. Are you a member of a benevolent association?
27. Are you a member of a military company?
28. Are you a member of any company or association, the rules of which would interfere with your work if employed by the Birmingham Railway, Light & Power Company?
29. Have you ever had a fit?
30. Have you ever fainted?
31. Do you know that while learning the road, and previous to taking charge of a car as an "Extra," you will receive no compensation?
32. Do you know that your retention in the service of the company will be based upon your record with the company?
33. Were you ever arrested?
34. Were you ever convicted of any crime?

I certify that the above answers, 1 to 34 inclusive, are true and correct.

Note.—It must be clearly understood by the applicant, previous to handing in this application, that the Birmingham Railway, Light & Power Company considers the following sufficient cause for immediate discharge: 1. Intoxication. 2. Dishonesty. 3. False statements, oral or written. 4. Gross ungentlemanly conduct. 5. Disloyalty to the company. If after employing the applicant, it is discovered by the company that any statements made by him in this application is false, it will be considered sufficient cause for his immediate discharge.

Witness:

Applicant.

Dated this day of 190

Birmingham, Ala., 190

(BACK OF EMPLOYMENT BLANK.)

BIRMINGHAM RAILWAY, LIGHT & POWER CO.,

Gentlemen:—We recommend Mr. to be an honest, reliable and skilful man for the position of

Very truly yours,

Despatcher.

Despatcher.

Conductor.

Motorman.

Birmingham, Ala., 190

BIRMINGHAM RAILWAY, LIGHT & POWER CO.,

Gentlemen:—After investigating the applicant's answers (1 to 34 inclusive), with the exception of those covered by the company's surgeon's report, I find them to be true and correct, with the following exceptions:

After investigating the reputation of the applicant I would report the following:

After going over the lines of the company with the applicant while in charge of a car, I would state that his work is perfect, with the following exceptions:

After a thorough examination as to his skill and knowledge of his work, knowledge of the rules and regulations of the company, and knowledge of the road and its requirements, I consider that he is entitled to a standing of per cent in the records of the company.

(Signed)

Despatcher.

Approved

Manager Railway Department.

The back of the application blank also contains the following file memoranda.

Application No. ; For position of ; Name, ; Address, ; Date, ; Relative standing on the list of applicants,

Previous reputation, per cent, Sample of work per cent, Written or oral examination per cent, Physician's examination per cent, Standing per cent, Accepted 190

The medical examiner's certificate follows:

MEDICAL EXAMINER'S CERTIFICATE

1. Name,
2. Address,
3. Apparent age,
4. Height (feet, inches),
5. Weight,
6. Color of hair,
7. Color of eyes,
8. General figure,
9. Shape of chest,
10. Full inspiration (inches),
11. Expiration (inches),
12. Expansion (inches),
13. Girth of abdomen (inches),
14. Is heart action normal?
15. What is pulse rate?
16. Is respiration full and normal?
17. Has applicant piles?
18. Has applicant fistula?
19. Has applicant varicose veins?
20. Has applicant any disease of genital or urinary organs?
21. Sight, right eye,
22. Left eye,
23. Hearing, right ear,
24. Left ear,
25. Has applicant been successfully vaccinated?

GENERAL PHYSICAL CONDITION

....

....

REQUIREMENTS

(1) Age 21 to 40 years; (2) standard height, 5 ft. 8 ins.; minimum height accepted, 5 ft. 4½ ins.; (3) ability to see with each eye ½-in. letters a distance of 10 ft.; (4) ability to hear a standard watch tick at arm's length with each ear; (5) good condition of heart, lungs, liver, kidneys, etc.

NOTE.—Applicants will not be accepted who have a rupture or any deformity. Applicants must show a satisfactory vaccination scar.

CERTIFICATE

I, the undersigned, do hereby certify that the applicant herein mentioned is .... physically qualified for active duty as

....

........................, M. D.

As stated, after the period of probation motormen are given a written examination. The questions used, which are printed in a small book and are afterward placed on file, follow:

EXAMINATION QUESTIONS FOR MOTORMEN.

GENERAL

1. Describe in a few words what you consider three main duties of motorman.

2. Name the principal streets and avenues of Birmingham on which the company operates cars.

3. Name the suburban towns reached by the system of the Birmingham Railway, Light & Power Company.

4. Describe the entire route of any two lines, by naming the streets and avenues over which each line operates.

5. Name in order every cross street or station on the line or lines on which you desire to work.

6. State the time of arrival and departure of the principal passenger trains from the Central Passenger Station.

7. State the location of the following:
Post Office.
City Hall.
Court House
Union Passenger Station.
Hotel Hillman.
Morris Hotel.
Metropolitan Hotel.
Florence Hotel.
The Auditorium.
Jefferson Theater.
St. Vincent's Hospital.

8. Mention the principal things that a motorman should know about the city.

9. Who is held personally responsible for violation of city ordinances?

10. What are the requirements of the city on the following subjects:
Stopping at steam railroad tracks?
Stopping at electric railroad tracks?
Passing by stopped cars?

11. To whom should you make complaint regarding another employee?

12. What is expected of an employee off duty, who witnesses an accident or any other matter in which the company may be interested?

13. What orders should a motorman obey from a conductor?

EQUIPMENT OF CARS

14. What is it necessary for a motorman to do in order to ascertain, in a general way, if his car is in proper condition to take out on the road?

15. In case a motorman finds that his car is not, in his judgment, in proper condition to take out on the road, what should he do?

16. Describe how you would turn on lamp circuit of car.

17. How would you turn on arc headlight?

18. Describe the proper way to start a car; supposing it takes fifteen seconds, what part of the time should be used on the different points?

19. In starting and stopping cars how should brakes be used?

20. What is the proper position of a motorman in operating a car, and where should his hands be?

21. When should sand be used?

22. When making a stop on slippery rails, how should sand be used to prevent flat wheels?

23. What is the difference between a ground and a short-circuit?

24. How many running points are there on a K-14 controller?

25. For what are these running points intended?

26. Describe how you would cut out a motor.

27. In running with four motors, if one becomes disabled, what should a motorman do?

28. When and how should a motor be reversed?

29. Suppose your controller should become unmanageable with current on, and you were not able to turn cylinder either forward or backward, what would you do?

30. Describe how you would put in a fuse.

31. Explain in a general way the system of air brakes in use by the company.

32. In case air brake should fail to work, what should a motorman do to stop car?

33. In case the brakes refuse to work, and trolley leaves the wire, what is the best method of stopping car?

34. In stopping car, if wheels slide, why is it necessary to release brake slightly, and then apply brake again gradually?

35. Why is it necessary for a motorman to watch the pressure gage of an air brake?

36. At what pressure is gage set for?

37. Should gage show excess of pressure, what should a motorman do?

38. How would you apply air in case of emergency?

39. Explain how to drain air from the air tank.

40. Explain in what position you should bring handle of air brake just before car comes to a stop.

41. What is the piston travel of brake cylinder when brake shoes are properly adjusted?

42. What application of air is necessary in descending grades?

43. On which side of controller box is switch to cut out motor No. 1?

44. Why should overhead switch not be thrown off while current is on?

45. How many fuses should be used if a car is blowing them out before cutting mortor out?

46. What would you do if a car has blown out two fuses while running on the last point?

47. In pulling trailers, if the draw-bar in either car should break, explain how you would replace the broken draw-bar.

48. If car is stopped and you get signal to go ahead, but car refuses to move, what would be the first thing you would do to find the trouble?

49. If you took a car out of house and found you could not move controller past five points, what would you do?

50. What would you do if, in avoiding an accident or after an accident, your brakes became locked ?

51. How can locking of brake-shoes be relieved?

52. What special caution should you use in closing a door?

53. What should be done regarding running through water?

54. What effect has feeding car too fast?

55. State what you would do in properly turning in your car at the car house for the night.

56. What is a lightning arrester?

57. If the current is cut off from power station what should a motorman do?

58. What is the quickest and best method of stopping any electrical trouble on car?

OPERATION OF CARS

59. When are you expected to consult the bulletin board for new orders?

60. Mention all blank forms which are to be used by motorman.

61. What blank form is filled out by motorman upon turning in car at house?

62. Name the telephones of the company, stating who you would expect to reach by calling up each number. Also mention among these the company's physician's telephone.

63. When a line wagon, or workmen, are on the track, how near should you approach and what precaution should you take?

64. Mention bell signals in use on cars of the company, and what each means.

65. After receiving signal, why is it well for a motorman to sound his gong several times before starting?

66. What precautions should a motorman take in foggy weather?

67. What special precautions should you take when handling extra or unscheduled cars?

68. What precautions should you take before starting car, when conductor has got off to flag crossing?

69. In crossing a steam railroad crossing, what are the least number of blocks which you should allow between an approaching train and the crossing before attempting to cross?

70. In case of the absence of a flagman from any point at which a flagman is usually stationed, what should you do?

71. Suppose you were flagged over a crossing when you, yourself, did not consider it absolutely safe to cross, what would you do?

72. What signals are used by steam railroads at crossings?

73. How are street railroad crossings flagged?

74. What are the rules regarding the proper places at which to stop a car?

75. What clock of the company is considered standard time for the regulation of your watch?

76. What is the only excuse for running ahead of time?

77. What is the proper way to throw a switch?

78. What is the proper position of car at switches on single track?

79. What are the rules in regard to cars running on wrong track?

80. When a car is not running on schedule time, or when two cars, each from different lines, are operated over the same track, what distance should be maintained from car ahead?

81. After a blockade, and cars have become bunched, how far should car just ahead of you proceed before you start your car, and why?

82. What is the round trip time on each line of the company?

83. Name the running time between different stations on each line.

84. Name the speed allowable at different points.

85. When a car is behind time, is a motorman permitted to run his car at a different rate of speed than if running on schedule time?

86. How long are you supposed to wait for an opposing train, after due time, at a meeting point?

87. Before going under a car to make repairs what precautions should you take?

88. If headlight will not burn, what should a motorman do?

89. What should you do in case trolley wire should break?

90. What precaution is necessary before coupling cars?

91. What vehicles have right of way over street cars?

92. What car of the company has right of way over all others?

93. In case of trouble with the wire, track or cars, delaying cars, what would you do?

94. Why should you never, under any conditions, back a car, to receive a passenger after running by him.

95. What is expected of employees in case of obstruction to the service?

96. If you saw or heard of a fire near the line, what would you do?

97. If a fire hose was stretched across the track what would you do?

98. In case of derailment or other blockade, if an officer of the company were not present, who should take charge of the work of relieving it?

99. If a conductor and motorman have anything to say to each other, so that the motorman's attention will be distracted from his duty, what should be done?

100. How many cars should be on a bridge at one time?

101. At what speed should cars be run over bridges?

102. What are the instructions of the company in regard to avoiding accidents?

103. Name all the duties of a motorman in case of accident.

104. Of what accidents it is necessary to make an oral as well as a written report, and to whom?

105. By whom is the accident report made out, and to whom addressed?

106. When, and to whom is it necessary to telephone information of an accident, and what information should be given?

107. Name the only persons to whom you should give any information if asked concerning an accident or the names of witnesses.

108. What would you do in case of accident to a party injured not very seriously, who refused to give his name. How would you report same?

109. What are the rules relative to ejecting persons from car?

110. What are the rules regarding the treatment of passengers?

111. What are the special rules relating to colored passengers?

112. When your car is crowded, or due to go into house, or for any other reason, and you are not taking on passengers, what should you do when flagged by persons desiring to take your car?

113. What are the rules relative to reporting for duty?

114. What are the rules relative to uniforms and badges?

115. What constitutes a miss?

116. What is necessary to do before laying off?

117. Under what circumstances is it permissible to side-track a car, and what would it be necessary to do?

118. What are a motorman's duties when he turns his car over to another motorman?

119. If summoned to jury duty, or called to court on an accident case, or for any other purpose whatever, what would you do?

120. Under what conditions, if any, are passengers allowed to ride on the front platform?

121. What are the requirements of the company in regard to an employee off duty, but wearing his badge or buttons: (1) as to conversation with a motorman or conductor on duty; (2) as to occupying seats?

122. Where and when are employees allowed to smoke?

123. What are the regulations of the company regarding the use of intoxicating liquors?

124. Whom would you allow to run your car while you are in charge of it, and under what conditions?

125. What precautions should a motorman take if it is at any time necessary for both the conductor and motorman to leave their car?

126. What are the principal points at which the speed of cars should be moderated?

127. What are the rules relative to passing cars at cross-overs and switches, when your car is running against the switch point?

128. When current is cut off at power station, what would be the object in a motorman's stopping his car at once, and not proceeding until current is turned on again, even if he could coast down grade?

129. How long after current comes on, supposing it has been off, would you wait before starting up?

130. At what points should current be thrown off?

131. What are the principal points at which especial watchfulness is necessary on the part of the motorman?

132. When you see a small child, unaccompanied on the street, what should you do?

133. Under what circumstances are you allowed to look back in car?

134. At what points should a motorman ring his gong, and where should it not be rung?

135. What are the rules of the company regarding lost articles?

136. What information would you give, should a person make inquiries of you regarding a lost article?

137. Under what conditions should both headlights be allowed to burn?

138. Whose duty is it to see that headlights are burning at proper times?

139. What would you do if your car should become unmanageable going down hill?

140. How should a car be run, in ascending grade, when track is slippery?

141. Where do you lower guard on open cars.

142. Within what distance can a motor car running at full speed be stopped on a level track, when the track is in average condition? On a down grade?

The cover contains a place for the name, date and line, and on the inside of the first cover is the following notice and form for recording name, date, standing, etc.

The applicant is required to answer such questions in reading, writing and arithmetic as will show that he has sufficient knowledge of these subjects to understand bulletin orders, work out trip-sheets and make intelligent reports of accidents.

Note:—The employment agent will prepare these questions at the time of the examination.

Application No.
For position of
Name
Address
Date
Relative standing on the list of applicants.

Previous reputation	per cent.
Sample of work	per cent.
Written or oral examination	per cent.
Physician's examination	per cent.
Standing	per cent.
Accepted	190

Examined,

Despatcher.

Approved,

Manager Railway Department.

The form for conductors is similar to that for the motormen, except in the list of questions. The form follows:

EXAMINATION QUESTIONS FOR CONDUCTORS.

GENERAL

1. Describe in a few words what you consider three main duties of the position of conductor.

2. Name the principal streets and avenues of Birmingham, on which the company operates cars.

3. Name the suburban towns reached by the system of the Birmingham Railway, Light & Power Company.

4. Describe the entire route of any two lines of the company, by naming the streets and avenues over which each line operates.

5. Name in order all cross streets and stations on the line or lines on which you desire to work.

6. State the time of the arrival and departure of the principal passenger trains at the Central Passenger Station.

7. State the location of the following:
Postoffice.
City Hall.
Court House.
Union Passenger Station.
Hotel Hillman.
Morris Hotel.
Metropolitan Hotel.
The Auditorium.
Jefferson Theatre.
St. Vincent's Hospital.

8. Name the principal things that a conductor should know about the city.

9. What are the regulations of the city on the following subjects:
Stopping at steam railroad tracks.
Stopping at electric railroad tracks.
Passing by stopped cars.

10. Are you to accept orders from anyone which you think would cause you to endanger your personal safety?

11. Who is held personally responsible for violation of city ordinances?

12. To whom should you make complaint regarding another employee?

13. What is it necessary for a conductor to do in order to ascertain in a general way if his car is in proper condition to take out on the road?

14. In case a conductor finds that his car is not, in his judgment, in proper condition to take out on the road, what should he do?

15. What portion of car is conductor expected to clean, and how often should it be cleaned?

16. What are a conductor's duties when he turns his car over to another conductor?

17. What is the proper position of conductor when not collecting fares?

18. Describe how you would put in a fuse.

19. If a car becomes grounded, due to dirt or dust being on the rail, what should be done?

20. What special caution are conductors required to take when a train or car is backing up?

21. Why would you never, under any conditions, back a car to receive a passenger after running by him?

22. Explain what your duty is in case trolley should break.

23. What precaution is necessary before coupling cars?

24. Before going under a car to make repairs what precautions should you take?

25. In case car should catch fire from motors, what would you do?

26. In a thunder storm, what precautions are necessary?

27. What special caution should you use in closing a door?

28. In pulling trailers, if the draw-bar in either car should break, explain how you would replace the broken draw-bar.

29. Explain how to turn the electric heaters on and off and what special precautions you should take in regard to electric heating.

30. What should you do if lamps will not burn?

OPERATION

31. What are the rules relative to reporting for duty?

32. What constitutes a miss?

33. What is it necessary to do before laying off?

34. What are the rules relative to uniforms and badges?

35. What are the requirements of the company in regard to an employee off duty, but wearing his badge or buttons: (1) as to conversation with an employee on duty, (2) as to occupying seats?

36. What is expected of an employee off duty who witnesses an accident or any other matter in which the company may be interested?

37. When and where are employees allowed to smoke?

38. What are the regulations of the company in regard to the use of intoxicating liquors?

39. How often are you expected to consult the bulletin board for new orders?

40. What are the rules regarding the proper treatment of passengers?

41. What are the special rules regarding colored pasengers?

42. Should any free passengers be allowed to occupy seats while paying passengers stand?

43. Should a transfer offered not be good, state fully what you would do, and how to report same.

44. What are the rules relative to ejecting persons from car?

45. What are the rules of the company regarding lost articles?

46. What information would you give should a person make inquiries of you regarding a lost article?

47. What clock of the company is considered standard time for the regulation of your watch?

48. What is the only excuse for running ahead of time?

49. What is the round trip time on each line of the company?

50. Name the running time between different stations on each line.

51. How long are you supposed to wait for an opposing train after due time at a meeting point?

52. What is the rule relative to allowing anyone to hang advertising matter in the cars?

53. What is the rule relative to allowing peddlers on cars?

54. What streets or stations are you required to announce?

55. What is the proper time to announce stations?

56. What is the rule regarding the proper ventilation of car?

57. Whose duty is it to see that headlights are burning at proper times?

58. Under what conditions should both headlights be allowed to burn?

59. Explain rules in regard to collection of fares.

60. What is the rule regarding the amount of change which a conductor must have?

61. Who are allowed to ride free, and when?

62. What kind of packages are permitted to be carried on cars?

63. What kind of packages are not permitted to be carried on cars?

64. What is the rule in regard to carrying dogs on cars?

65. What should you charge for bicycles, trunks, empty coffins, a corpse?

66. Explain rules regarding collection of fare for children.
67. Under what circumstances should fare be returned, and how would you report same?
68. If a passenger should accidentally ring up a fare what should you do?
69. If a passenger should offer you money that the company would refuse to take, and would not give you any other, what would you do?
70. What would you do if a lady should not have change to pay her fare and wished to be carried?
71. What would you do, if children or old and infirm persons were put on your car and their fare paid and destination told, and you should carry them by, or forget that their fare had been paid?
72. Under what circumstances would you put a person off of your car?
73. Under what circumstances are you forbidden to collect fare from passengers?
74. How much of his uniform must a policeman have on to be passed free?
75. What would you do if a policeman, not in uniform, refused to pay his fare?
76. If a bill in excess of the amount which you are supposed to carry should be presented for fare, and you could not change it before pasenger got off car, what would you do? What would you do if the bill was one that you were supposed to be able to change?
77. Should a fare register fail to work what should a conductor do?
78. Explain rules relating to passes and tickets of various kinds.
79. Explain the proper method of registering cash fares, tickets, passes, transfers and freight, and how you would report same on trip sheet.
80. When are you expected to turn register back?
81. Explain how to register at terminus office?
82. What are the different headings on a trip sheet?
83. What are the rules of the company regarding transfers, and at what points are they issued?
84. Explain regulations governing the handling of United States mail.
85. Mention bell signals in use on the cars of the company, stating what each means.
86. How long before arriving at a point at which it is desired to stop should a conductor give signal?
87. What orders should a motorman obey from a conductor?
88. Mention name and use of all blank forms in use by conductors.
89. Where do you lower guard on open car?
90. What are the instructions of the company in regard to avoiding accidents at the rear of car?
91. In a conductor's department, what accidents are most liable to happen, and what precautions can he take to avoid them?
92. Name all the duties of a conductor in case of accident.
93. Of what accidents is it necessary to make an oral as well as a written report, and to whom?
94. By whom is the accident report made out, and to whom addressed?
95. When and to whom is it necessary to telephone information of an accident, and what information should be given?
96. Name the only persons to whom you would give any information regarding an accident, or the names of witnesses, if asked concerning same.
97. What would you do in case of accident to a person injured, not very seriously, who refused to give his name? How would you report same?
98. Name telephones of company, stating who you would expect to reach by calling up each number. State telephone number of company's physician; also hospitals.
99. In case of trouble with wire, track or car, delaying cars, what would you do?
100. If you saw or heard of a fire near the line what would you do?
101. If a hose was stretched across the track what would you do?
102. In case of derailment, or other blockade, if an officer of the company were not present, who should take charge of the work of relieving it?
103. What is expected of employees in case of obstruction to the service?
104. If your car was obstructed, unnecessarily, by a wagon or in any other way, what would you do?
105. In case you discovered that your car had to be run in, what would you do?
106. What are a conductor's duties before leaving his car in house?
107. What are the rules in regard to cars running on wrong track?
108. How are street railway crossings flagged?
109. State exactly how you should flag a steam railroad crossing; what are the least number of blocks which you should allow between an approaching train and the crossing before flagging car over; and what crossings do not have to be flagged by a conductor?
110. What are the signals used by steam railroads at crossings?
111. In case of the absence of a flagman at any point at which a flagman is usually stationed, what should you do?
112. What are the rules regarding the proper places at which to stop a car?
113. What is the proper position of a car when stopped at a street crossing?
114. What special precautions should be taken in foggy weather?
115. If the motorman and conductor have anything to say to each other, so that the motorman's attention will be distracted from his work, what should be done?
116. Under what circumstances would it be permissible to side-track a car, and what would it be necessary to do?
117. If your motorman should become disabled or sick, and it was necessary for an extra man to relieve him, what is the conductor's duty?
118. If summoned to jury service or called to court on an accident case or for any other purpose whatever, what would you do?
119. What employees of the company are allowed to ride on the front platform?
120. Under what conditions, if any, are passengers allowed to ride on the front platform?
121. Under what circumstances, if any, should you act as motorman?
122. At what points should a conductor give especial attention to his trolley?
123. How long after curent comes on, supposing it has been off, would you wait before starting up?

The applicant is required to answer such questions in reading, writing and arithmetic, as will show that he has sufficient knowledge of these subjects to understand bulletin orders, work out trip-sheets and make intelligent reports of accidents.

Note—The employment agent will prepare these questions at the time of the examination.

Application No.

For position of	
Name	
Address	
Date	
Relative standing on the list of applicants	
Previous reputation	per cent.
Sample of work	per cent.
Written or oral examination	per cent.
Physician's examination	per cent.
Standing	per cent.
Accepted	1901
Examined	

Despatcher.

Approved.

Manager Railway Dept.

Pneumatic Tool Companies Consolidate

Final details have been completed for the consolidation of pneumatic tool companies, which will control the greater part of the output of the world. The new corporation, which has been organized under the laws of New Jersey, is known as the Chicago Pneumatic Tool Company, and includes the Chicago Pneumatic Tool Company, Boyer Machine Company, of Detroit; Chisholm & Moore Manufacturing Company, of Cleveland; Franklin Air Compressor Company, of Pennsylvania; New York Air Compressor Company, of New York, and the New Taite-Howard Pneumatic Tool Company, of London, England. J. W. Duntley, of Chicago, is president; Leroy B. Beardsley, of Chicago, is secretary, and Max Pam, of Chicago, general counsel.

The Northern Ohio Traction Company, which has secured control of the Canton-Massillon Railway and city lines in Canton and Massillon, Ohio, has issued an announcement that hereafter no free transportation will be issued to anyone. Heretofore all city officials and employees have been given free tickets. The new order is in accord with the general policy of the Everett-Moore syndicate for all lines under its control.

Notes on Electric Railway Practice in Germany

As previously stated in these columns, the Institution of Electrical Engineers made a visit to Germany last summer, and an inspection was made of the principal electrical installations and works in the cities visited. Some particulars of the visit, written by the well-known engineering writer, E. Kilburn Scott, have already been published in these pages. The official report of the committee on traction, light and power distribution of the institution has just rendered its report of the visit, and from it the following extracts are made.

ABSTRACT OF REPORT

Prime Movers.—The first thing that strikes an English engineer on entering a German engine room is the magnitude and frequently the elaboration of the buildings.

The engines commonly used are horizontal slow-speed of from 100 r. p. m. to 80 r. p. m., though in some cases vertical engines are found. The finest examples of the latter were the four-cylinder, triple-expansion sets seen in the Luisenstrasse works in Berlin, where three each of 3000 ihp by Messrs. Sulzer are at work. It is generally considered that although the vertical engine occupies somewhat less ground space, it costs more in attendance and is higher in prime cost, which may be the reason for the Berlin company adopting horizontal engines for their new stations where the units are each of 4500 ihp. The personal element also influences the adoption of horizontal engines, as we learn that men do not give the same attention to the working parts if they have to climb ladders to get at them. Those of us who were in the Paris Exposition last year must have been much struck with the number of men employed on the galleries of such engines as Messrs. Borsig's magnificent vertical.

The enclosed-type high-speed engine so common at home is conspicuous by its absence on the Continent, although some makers are now partially enclosing their vertical types.

In horizontal sets the draft caused by the dynamos has been found to draw the oil from the connecting rods and crank bearings on to the winding, and in order to overcome this the frames or trunks of horizontal engines are now much more enclosed than was usual before dynamo driving had to be considered; the greatest advance in this direction being seen in the new 1000 ihp sets at present being fixed at the Dortmund works.

Forced lubrication as understood at home is unknown, though definite plunger feed lubricators are generally used instead of gravity sight-feed drop lubrications for cylinders. The highly finished valve-gear on the slow-speed engines would appear to need considerable attention, but it is commonly found that well-finished machinery gets well looked after by the attendants, who take more pride in an engine that looks well when it is clean than in more roughly finished work that barely shows when it is clean or not. Good lubrication and hardened wearing parts for the trips of the valve-gear reduce wear and tear to a minimum, and the engineers in charge report that repairs are insignificant.

Boilers.—Water-tube boilers, with the tubes expanded into a common header, are almost universal, and superheating up to 50 deg. C. is very common, generally by separately fired superheaters, although in some cases nests of tubes are used in the boiler setting. In a few cases economisers are used, but they do not appear to be as general as in England. Furnaces show a very interesting departure from English practice in inclined gates of the Tenbrink type.

In spite of the "Verboten" issued against smoking two years ago, we saw a good deal from the chimneys in many towns. In Berlin the City Council control the emission of black smoke and for that reason the electricity works are restricted in the use of coal which, we understand, has been up to the present purchased from Cardiff. At the Moabit station, which is on the outskirts of the city, a class of coal very similar to our midland slack is used, while further out at Oberspree brown coal is used. In both these latter cases we are told no trouble from smoke was experienced.

Bucket elevators and belt conveyors for coal were seen in the Allegemeine Elektricitäts Gesellschaft station and the Siemens & Halske's Overhead Railway Plant in Berlin, also in Dresden, though tip-trucks delivering coal in front of the boilers appear to be the rule. Mechanical stoking is conspicuous by its absence.

In Dresden, where brown coal is used and automatically fed on to the grates, the ashes being taken away in the basement, the boiler room is cleaner than many engine rooms. In Essen a very interesting example of firing with waste gases from the adjoining coke ovens has been arranged for, though at present coal is being used.

Generators.—Dynamos are very large everywhere, the slow-speeds generally obtaining making even 300-kw machine impressive. Splendid examples of machines of over a thousand kilowatts were seen at Berlin, Dresden, Essen, etc. The continuous-current fly-wheel generators are of special interest. These machines are a specialty of the E. A. G. vorm. W. Lahmeyer & Company, and are erected in many of the central stations built by them. Such machines were seen running at the central stations of Dortmund, Dusseldorf, and Homburg.

Two continuous-current machines direct driven by the same engine and connected alternatively in parallel for lighting or in series for traction may be seen in Berlin and Dusseldorf. In Homburg, one engine may be seen driving two generators of different pressure and size for traction and lighting, the traction generator acting as fly-wheel for the whole set. This interesting arrangement requires very little space, and is due to Messrs. Lahmeyer.

In the factories visited a rough guess would place the direct and alternating-current machines under construction as about equal in number and importance, although actually the largest machines were alternators. Under the latter class there were very few single or two-phase machines to be seen. For new work, inductor alternators are practically extinct; not a single one was seen under construction in any of the shops, and although this may have been an accident, certainly their proportion to the whole number built must be small. The continuous-current fly-wheel generators for the extension of the Duesseldorf and Dortmund Municipal Works, and for the central station at Muenster, driven by gas engines, aroused especial interest, as also did the H. T. 1600 kw generators for 10,000 volts direct pressure. A number of synchronous and asynchronous motor generators up to 450 hp for the same high pressure were also nearing completion. A remarkable instance of direct-coupled machines appears in the motors for pumping plants, of which quite a number, varying from 300 hp to 600 hp at 60 r. p. m. to 80 r. p. m., were to be seen in the workshops of Messrs. W. Lahmeyer & Company in the course of construction.

For the general purposes of transmission and lighting a standard periodicity of fifty is now almost universal in Germany, the variants of forty and sixty being seldom found. Rotaries up to 800 kw at this periodicity in the Berlin sub-stations.

Rotaries and synchronous motor generators were seen at Berlin and Frankfort, respectively, under very similar circumstances, both being at work on traction loads, and on their respective merits there was little to be gleaned without a closer knowledge of details. The arrangement of a direct-coupled booster on the alternating side as seen at Augusta Strasse, Berlin, due to Herr Dobrowolski, by means of which the primary pressure can be varied, overcomes the difficulty of the fixed ratio of conversion in the rotary.

Storage Batteries.—The use of storage batteries is much greater in Germany than in this country, the proportion they bear to the generating plant often reaching 20 to 25 per cent. They are used not only to level the load on the generators, but in Frankfort they enable synchronous motor generators to be used for the conversion of single-phase current to 500 volts continuous current for the trams, such use having been found simple and successful, and it is stated that they completely stop the hunting of the motors.

The batteries in Frankfort are charged by an induction motor driven booster, and in the Augusta Strasse station of the Berlin company by a combination of rotary converters and synchronous machines.

The positive plates are generally of the Plante or formed type, while the negative are Faure or pasted type, and maintenance contracts with the makers appear to be the rule rather than the exception.

Cables.—As regards cables for the transmission from Oberspree, over 9 miles, 6000 volts is the chosen voltage, and at this pressure the mains are laid under ground. The general type of cable employed by the Allgemeine Elektricitäts Gesellschaft for transmission at moderately high pressures was said to be insulated with impregnated jute, lead-covered and armored and buried in a bed of clean sand direct in the ground; for pressures from 5000 to 10,000 volts impregnated jute, rubber and a covering of paper, lead sheathing and armoring; for higher pressures up to 20,000 volts rubber and stabilit instead of jute, experiments being shown to demonstrate the superiority of the stabilit cable at the Oberspree Cable Works.

The cables from Oberspree are twisted three-core, and seven are used to feed the sub-station at Mariannenstrasse, which takes about 7500 hp, so that the power transmitted by each cable must be at least 1000 hp, and probably to allow of reserve capacity, each cable transmits about 2000 hp. The best practice appears to be double cables in sections with triple-pole 2-way switches, so that the reserve sections may be switched in in the event of a fault occurring. Lightning arresters are freely used, but we were not able to obtain any definite information about the general practice in transmission lines.

Tramways.—For tramways 550 volts is still the rule, and the sliding bow appears to be extending faster than the trolley.

The span wire is usual, the trolley wire being everywhere kept as close as possible to the center of the track. The sliding bow introduced by Messrs. Siemens, with its friction surface of aluminum crossed lengthwise for lubrication, gives a simpler overhead construction at curves and junctions and more latitude in the position of the overhead wire. The sliding of the bow gives quieter running than trolleys, but it is very doubtful if on the whole the system be preferable to the better examples of swinging trolley equipment seen in England..

The rail-joints are often the scarfed, which gives smooth running. Lightning arresters of the Horn or Siemens type are largely used for traction service and placed above tramcars, with a gap of about ⅛ in. for 500-volt circuits, the width of the horns at the top being about 5 ins. Wider streets, and the fact that cars do not stop except at their recognized stopping places, enables high speeds to be run.

Accumulator cars are much used in the center of large towns, notably in Dusseldorf and Berlin, although in Dresden Messrs. Siemens' conduit system has been adopted through the center of the town. This modification does not appear to be due so much to economical reasons as to meet the æsthetic views of the municipalities concerned.

The Suspended Railway.—The Langen mono-rail suspended railway from Barmen to Eberfield marks an epoch in railway work. The line, which is rather more than 8 miles in length, runs for some 6 miles over the bed of the winding river Wupper, carried on A-frames about 30 yards apart. The other 2 miles, over narrow streets and country roads, is carried on horseshoe-shaped frames, as they offer less obstruction to traffic than the sloping sides of the A-frames. The under side of the cars is about 15 ft. above the street level. The track is double, providing for "up" and "down" trains of two fifty-passenger cars, which are each suspended from two bogies 26 ft. apart. Each bogie has two wheels 35 ins. in diameter running on the single rails with an overhung 36-hp motor between them, whose pinion engages with spur wheels on the axes of the 35-in. driving wheels.

The 550-volt direct current to the two lines is supplied by separate Sulzer-Schuckert 850-kw generators. There are also buffer batteries in the generating station, to insure safety. The current is picked up by contact shoes, which are pressed by spiral springs on to an ordinary round-headed iron rail conductor. The track is divided into automatic block sections, and trains can be run every three minutes at a speed of thirty miles an hour. The whole of this novel electrical equipment was designed and constructed by Messrs. Schuckert, of Nuremberg.

The Relation of Energy and Motor Capacity to Schedule Speed in the Moving of Trains by Electricity

BY CARY T. HUTCHINSON

The determination of the energy and power necessary to make a certain schedule speed from start to start under various conditions of initial accelerations, braking and use of the "motor curve" is a matter of much practical importance. A number of articles discussing special cases have been published. This paper gives a general solution of the question involved in the movement of a body from rest to rest, with velocity varying as shown in Figs. 1 and 2—these two figures illustrating the practical problem of train acceleration. The solution here given covers all cases that can arise in ordinary practice of train movement.

The solution is partly analytical and partly graphical; it may be divided into three stages: (1) The determination of the elements of Fig. 1 to give any schedule speed; this velocity-time (v-t) curve I shall refer to as the "type curve." (2) The determination of a general tramway motor curve sheet and the deduction from this curve sheet of several dependent curves; and (3) the application of the general motor curves to the type curve of Fig. 1 to obtain a general solution of the (v-t) curves of Fig. 2. Each case of Fig. 2 is reduced to a case of Fig. 1 by applying a correction to Fig. 2, represented by the area M A N, by which it is reduced to a corresponding case of Fig. 1.

Throughout the following units are used:

Velocity, in miles per hour.

Acceleration, in miles per hour per second.

Distance, in feet.

Time, in seconds.

Weight, in pounds.

Power, in kilowatts.

Energy, in watt-hours.

In this system "g" the acceleration of gravity is 22; the ton is uniformly 2000 lbs.

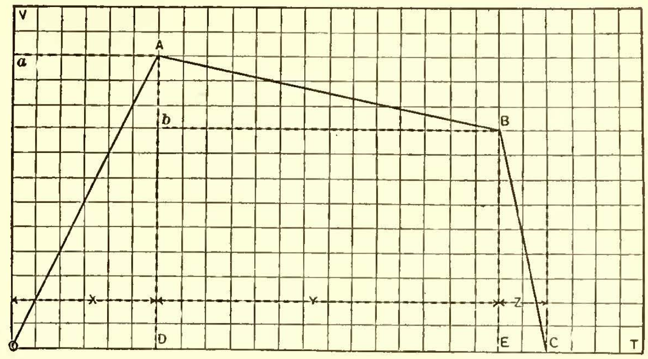


FIG. 1

Let

a = Acceleration along O A = D A/O D
b = Retardation along A B = A b/E D
c = Retardation along B C = B E/E C
x = Time for O A = O D
y = Time for A B = D E
z = Time for B C = E C

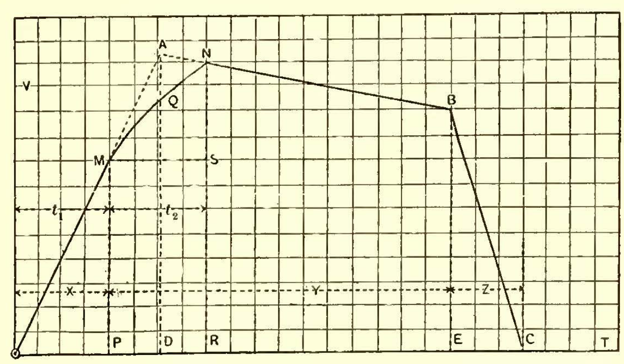


FIG. 2

s_1 = Distance for O A = Area O A D
s_2 = Distance for A B = Area D A B E
s_3 = Distance for B C = Area E B C
T = Total time = O C
L = Total Distance = Area O A B C
V Average velocity = .682 L/T

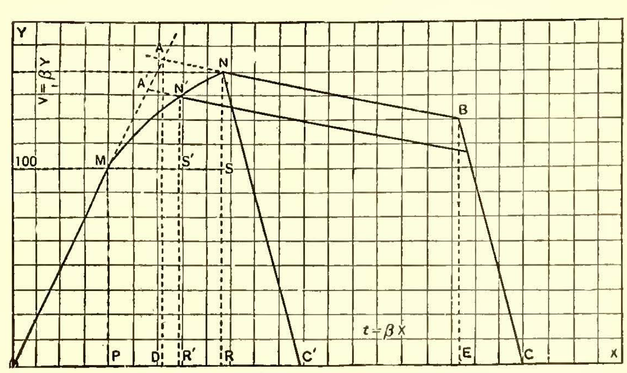


FIG. 3

Put

$$A = V/T = .682\, L/T^2 = 1.47\, V^2/L \qquad (4)$$
$$2\, A_0 = a\, c/(a + c) \qquad (5)$$
$$2\, M = (a + b)\ (a + c)\ (c - b)$$
$$K_1 = (c - b)/M^{1/2}$$
$$K_2 = (a + c)/M$$
$$K_3 = (a + b)/M^{1/2}$$

Where

$$K_1 + K_2 + K_3 = 0$$

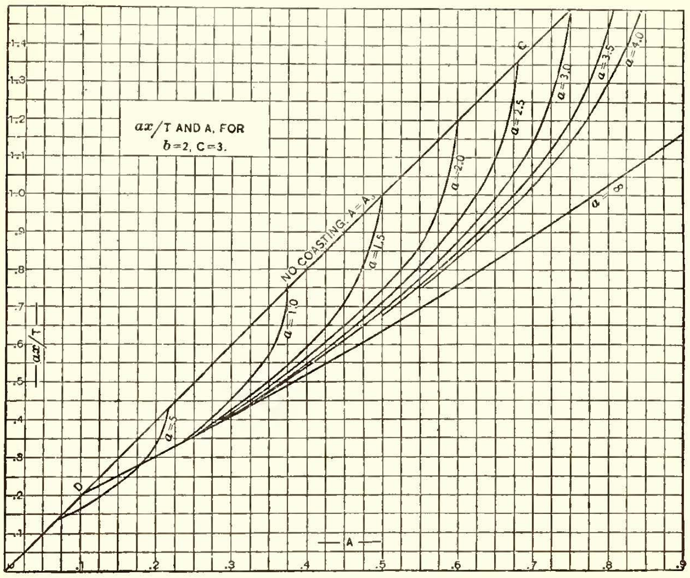
* Abstract of a paper presented at the meeting of the American Institute of Electrical Engineers, New York, Jan. 24, 1902.

Then will

$$x/T = 2\,A_0/a - K_1\,(A_0 - A)^{1/2} \qquad (6)$$
$$y/T = \qquad K_2\,(A_0 - A)^{1/2} \qquad (7)$$
$$z/T = 2A_0/c - K_3\,(A_0 - A)^{1/2} \qquad (8)$$

And

$$a\,x/T = 2\,A_0 - a\,K_1\,(A_0 - A)^{1/2} \qquad (9)$$
$$b\,y/T = \qquad b\,K_2\,(A_0 - A)^{1/2} \qquad (10)$$
$$c\,z/T = 2\,A_0 - c\,K_3\,(A_0 - A)^{1/2} \qquad (11)$$



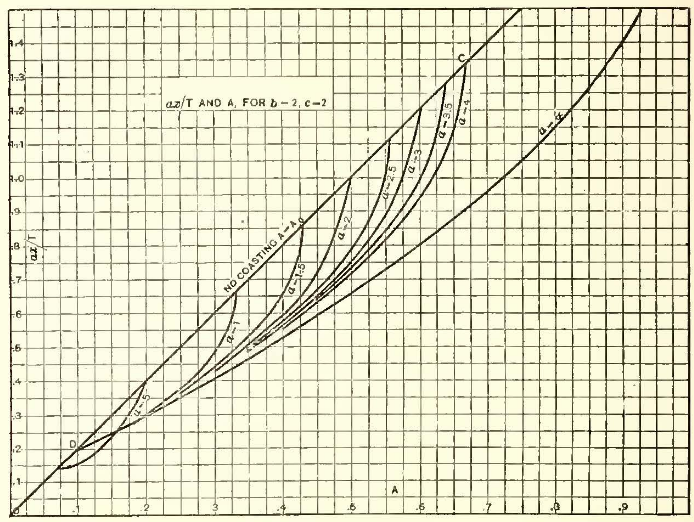
CURVE SHEET 3

These three equations are the general solution of the problem in kinematics illustrated in Fig. 1; that is, the motion of a particle from rest to rest, with three different accelerations. The only term in the equations containing the average velocity or the length is A; all the other terms are functions of the three accelerations. This quantity A then determines completely the schedule. All schedules having the same value of A will be accomplished by the same accelerations in the same proportional times; that is, the same fraction of the total time will be occupied in the three phases of the movement. This quantity is then the independent variable and is of utmost importance in this discussion; it deserves a specific name, and for want of a better I shall call it the "through acceleration," and denote it by A.

Curve sheet 3 is plotted from equation (9), and gives $a\ x/T$ in terms of A for different values of (a), and for $b = .2$, $c = 3$. These curves show at a glance the variation of maximum velocity with different initial acceleration, and the crossing of the a-curves.

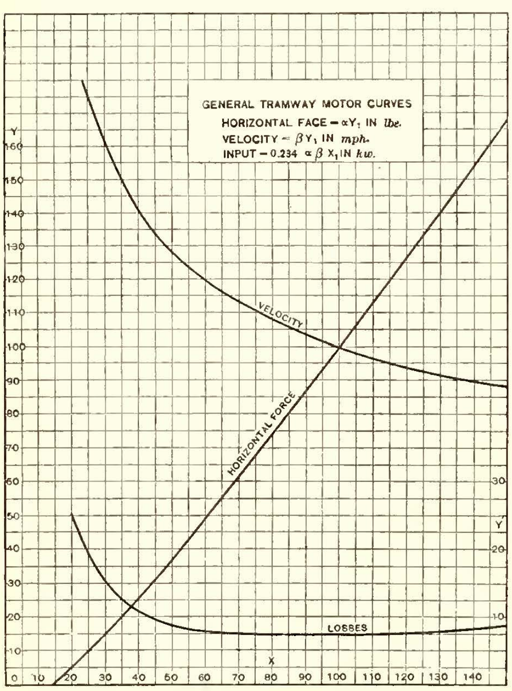
Curve sheet 4 shows $a\ x/T$ in terms of A for $b = .2$ and for $c = 2.0$. It illustrates the influence of the braking effort on the maximum velocities.

These curve sheets give a complete determination of the kinematics of the problem. There remains the determination of energy and power—the kinetics. I limit the discussion to the case in which power is applied along O A (Fig. 1) only, and the car is allowed to "coast" with gradually diminishing velocity due to the constant retardation (b) from A to B where a braking force producing a retardation ($c - b$) is applied, making a total retardation equal to (c).

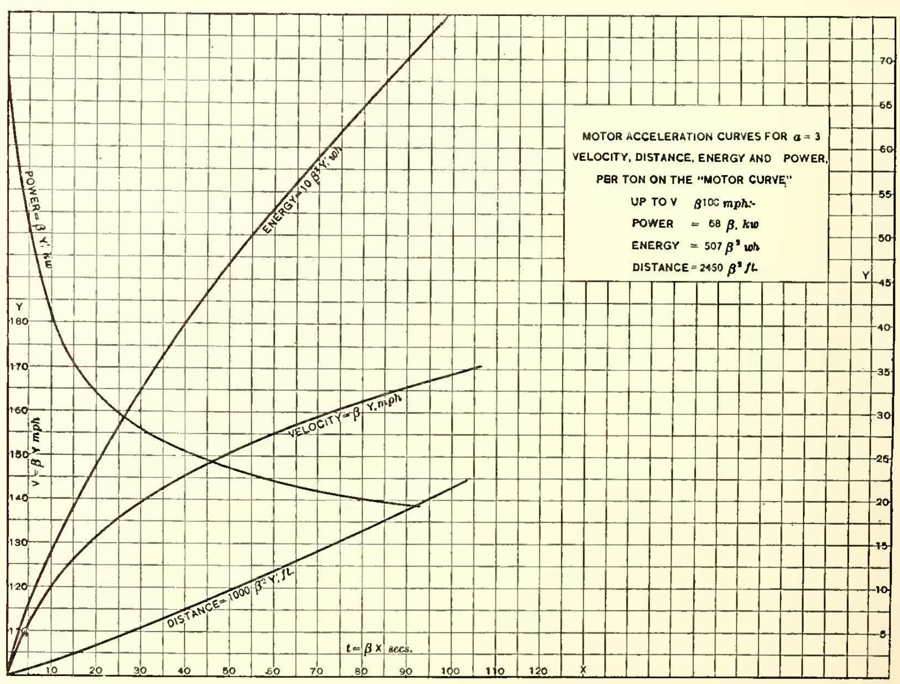


CURVE SHEET 4

The assumption of (b) constant is necessary to a simple discussion; if it is not so, an average value may be used—considerable variations in the value of (b) make little difference. I use throughout $b = .2$ M.P.H./sec., equal to a force 18.2 lbs. per ton; (b) represents the total tractive resistance on a level at uniform speed, and with electric motors, includes motor friction.



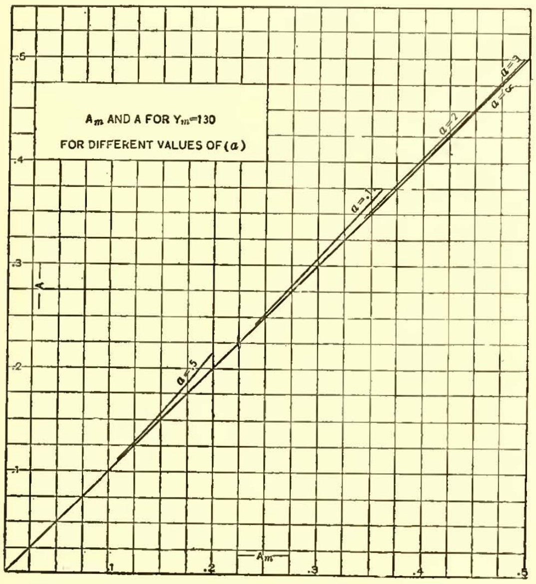
CURVE SHEET 5



CURVE SHEET 6

General Motor Curves.—In order to make the discussion general, it is not sufficient to consider one or two sizes of motor or one or two gearing ratios—all sizes and all gear ratios must be included, or what is the same thing, all values of torque at the axle and all values of velocity; in a word, a set of motor curves applicable to all sizes of motors must be prepared.

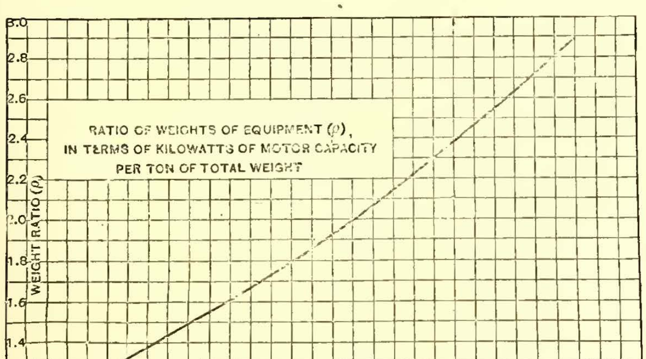
I have plotted the values of torque and speed in terms of input for some twenty tramway motors of different sizes and makes, expressing all quantities in percentage of their value at rated load, and find that the agreement is close—so close that one set of curves can with sufficient exactness for this purpose be used for almost any modern tramway motor built in the United States. It is immaterial whether this general motor curve represents any particular motor. By using this curve, the identically same characteristics are retained for all initial accelerations, hence the use of such a curve brings out the differences due to the different initial ac-



CURVE SHEET 10

celerations without complicating them by the differences in individual motor characteristics. Curve sheet 5 is this general tramway motor curve; abscissæ are input in kilowatts; ordinates are horizontal force (f) in pounds, and speed (v) in miles per hour; on these curves the rated load is the point (100,100) and is the rating on a one-hour basis, heating to 75 degs. C.—the common tramway motor rating. Losses also are plotted; they differ much more in various motors than do (f) and (v).

Let $\beta\ Y'$ be the velocity and $a\ Y''$ the horizontal force; then every variation in conditions can be met by giving suitable values to a and β; this use of horizontal force and linear velocity eliminates the gearing ratio and size of wheel, both of which are



CURVE SHEET 15

determined by considerations outside of this discussion. Then for any value of X,

$$f = a\ Y'' \text{ in lbs.}$$

$$\text{and } v = \beta\ Y' \text{ in mph.}$$

The output is

$$[a\ \beta\ Y'\ Y''] / 503 \text{ kw}$$

and the input is

$$[a\ \beta\ Y'\ Y''] / (e \times 503) \text{ kw}$$

where e is the efficiency at the point (X, Y', Y'') taken from the motor curve sheet. Choosing the point (100,100,100), the rated load, then $e = .85$, and the input is

$$P = 0.234\ a\ \beta\ X, \text{ in kw.} \qquad (19)$$

This determines the constant multiplier for the input in terms of a and β.

An example will make the use of these curves clear; suppose a motor is to exert a horizontal force of 2000 lbs. at a speed of 20 mph.; if this is required at the rated load, then

$$a = 20, \quad \beta = .2$$

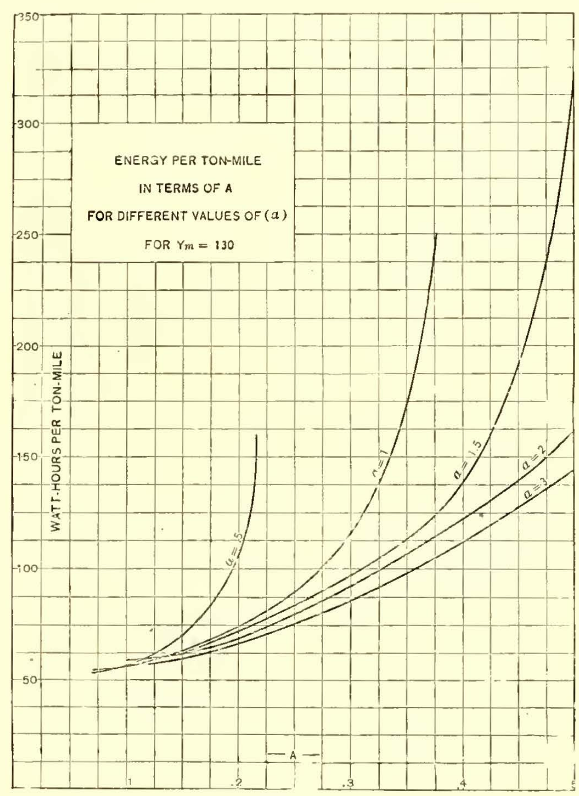
and

$$P = 0.936\ X \text{ kw}$$

at rated load this motor is 93.6 kw.

Acceleration Curves.—M (Fig. 2) is the point where the external resistance is all out of the circuit, and the motors begin to run on the "motor curve." The force exerted along O M is proportional to $(a + b)$. Assume this force to be the rated force of the motor and represented by the point $Y'' = 100$ on the general motor curve. The velocity at M is the rated velocity, is represented by $Y' = 100$, and is equal to β 100 M.P.H. The acceleration on the motor curve continues to a point N, where the velocity $\beta\ Y'$, Y' having any desired value greater than 100. The shape of the curve M Q N depends on the relative values of (a) and (b). If a/b is large the curve is steep; if small, flat.

A set of curves is obtained for each value of (a), which I call the acceleration or $(v\text{-}t)$ curve of the motor. The input corresponding to each velocity can be plotted on the same sheet, forming a (kw-time) curve, and from the last by integration an energy curve. Also from the $(v\text{-}t)$ curve, by integration, a curve of distance and time can be plotted. This gives a set of curves for each value of the initial acceleration, showing at once the power, energy, velocity and distance up to any relative velocity on the motor curve.



CURVE SHEET 13

Correction to Type Curve.—This discussion and the curve sheets deduced from it determine all the elements of the type curve, O A B C. This type curve bears a certain relation to the motor curve O M N B C. The distance traversed in the first case will be greater than in the second by the equivalent of the area M A N. It is then possible to reduce each case for the motor curve to a corresponding case for the type curve, by applying a correction, calculated in the following manner:

Determine the area M A N of Fig. 4 for each (a), and for any desired number of points on the motor curve; call this area Δ; hen $1.47\ \beta^2\ \Delta$ is the distance in feet represented by the area.

Let

Y_t be the maximum velocity A D on the type curve;

Y_m be the maximum velocity R N on the motor curve;

A be the through acceleration on the type curve;

A_m be the through acceleration on the motor curve;

and

X be $\overline{O\ C}$

Y_t is found from curve sheets 6 et seq., and λ from curve sheet 2, for any values of A, (a) and Y_m; A_m is then calculated, and plotted in terms of A, using the values of Δ previously calculated.

The values of A_m for all values of A, Y_m and (a), have been determined in this way; the corrections for values of Y_m less than 130 are too small to be taken into account; as I shall show, the minimum energy required for all schedules and for all values of (a) is practically at $Y_m = 130$; in some cases greater values of Y_m give slightly less energy, but the difference is so trifling that I have used only this value in discussing the energy relations.

Energy Input.—The energy at the car axle has already been determined; the electric input depends upon the method of motor control and the efficiency of the motor. I assume that series-parallel control of two steps is used. The power at the axle at rated velocity, that is, point M, is then 0.85 P_0, where P_0 is the rated power, and the power at the axle is proportional to the speed. The change from series parallel is assumed to occur at half-speed; the efficiency of the motors will be about 70 per cent when in series and carrying rated current. With these figures the input up to $v = \beta$ 100 is

$$W_0 = .8\ P_0\ t_1, \qquad (28)$$

and the output is

$$W' = .425\ P_0\ t_1,$$

hence the efficiency up to rated velocity—while resistance is in circuit—is 53 per cent.

Substituting for P_0 its value, and $t_1 = 100/\beta$ the input of electric energy per ton up to the point M is

$$W_0 = 475\ (1 + b/a)\beta^2 \qquad (29)$$

The values calculated from this equation are included on curve sheets 6, 7, 8 and 9, giving the energy up to the point $v = \beta$ 100. The input from the point M to the point N on the motor curve is taken directly from curve sheets 6 et seq., depending upon the initial acceleration.

The energy for all schedules can now be calculated by multiplying β^2 from curve sheet 12 by the constants given in table 1. The values so calculated for $Y_m = 130$ are plotted on curve sheet 13.

TABLE I.

Energy up to $v = \beta$ 100 and $v = \beta$ 130

(a)	v β 100	v β 130
.5	665 β^2	1115 β^2
1.	570 "	865 "
1 5	535 "	800 "
2.	522 "	767 "
3.	507 "	732 "

I have calculated the energy consumption in this manner for all values of Y_m and for the different values of (a) and of A, up to $Y_m = 160$. To give all these results is of no value, since the result shows that in nearly all practical cases the energy input is substantially a minimum for $Y_m = 130$. Table 2 below shows the relative energy for different values of Y_m for $(a) = 2$, in terms of energy for $Y_m = 130$, as 100 per cent, for the various values of A.

TABLE 2.

Relative Energy for Different Use of Motor Curve for $(a) = 2$. in Terms of Energy for $Y_m = 130$ as 100 Per Cent.

Y_m	A				
	.5	.4	.3	.2	.1
160	....	102%	97%	91%	89%
150	104%	101.5	98	93	93
140	100	100	99	95.5	95
130	100	100	100	100	100
120	103.5	106.5	106.5	108.5	105
110	110	112.5	113	112	108
100	119	122	121	128	120

This table is a fair example; it shows that the difference between the energy for 130 and greater values of Y_m is comparatively small. In the rest of this discussion I use this value of Y_m only, and the values of β are for this reason given only for $Y_m = 130$.

Curve sheet 13 gives at once the answer to all questions regarding the energy required for any schedule; it shows clearly how slight is the saving in energy effected by the use of rapid accelerations. For instance, for $A = .25$, the energy for an acceleration of 1 mile per hour per second is 17.2 wh.; for an acceleration of 3 mph./sec. it is 14.5 wh.; that is, increasing the acceleration in the ratio of three to one diminishes the energy required only 16 per cent.

Motor Capacity.—This discussion has been based throughout on the assumption that the motor operates at the rated capacity on the one-hour basis, when at the point M (Fig. 4). On this assumption a table can be compiled giving the capacity of the equipment required.

Hour Rating.—The one-hour rating of a tramway motor is much in excess of the continuous capacity; approximately such a motor will carry its rated output for 25 per cent of the total time; that is, for one minute out of four; the heat generated at rated capacity for one-quarter of a complete cycle will bring it to its rated temperature. It is assumed that the cycles are repeated at such intervals that a permanent regime is attained. This is only an approximation, but is a fair one, if the percentage be more or less than 25, and the conclusions can be altered to accord.

As the average heat losses at rated load are 12 per cent, it follows that such a motor can dissipate continuously 3 per cent of its rated capacity; when the average rate is over 3 per cent the motor is overloaded.

Weight of Equipment.—These curve sheets show that the motor capacity for high initial accelerations is generally greatly in excess of the motor capacity required for low initial accelerations. Greater capacity of equipment necessarily means greater weight of equipment, not only in the motors themselves, but also in the trucks, controllers and other parts. This entails the further necessity of more energy to carry this greater weight; each addition of weight means a further addition to the energy necessary. To get a correct comparison of the total energy per mile required for different initial accelerations the values of curve sheet 13 should be multiplied by the ratio of the necessary weights in the two cases. For instance, for an initial acceleration of 3 mph./sec. the total weight of equipment may be 25 per cent greater than for an initial acceleration of 1 M.P.H./sec.; the total energy used per mile will then be increased in the ratio of increase of the weights.

I have taken the weights of all parts of a car equipment in detail for different capacity of motors, varying from 30 to 150 rated H.P., for both two and four-motor equipments. These weights include motors, controllers, trolley poles, car wiring, motor trucks, trail trucks and car body. I have deduced from these weights curve sheet 15, on which the ordinates show the ratio of weights for different capacity of equipment in terms of kw/ton of total weight as abscissæ. For instance, for an equipment of 4 kw/ton of total weight the ratio is 1.44; for an equipment of 8 kw/ton the ratio is 1.93; the increase of equipment from 4 to 8 kw/ton then increases the total weight in the ratio of 1.93/1.44 = 1.34; that is, doubling the equipment means an increase of 34 per cent in total weight; hence 34 per cent in total energy used. The ordinates of curve sheet 13 giving energy per ton mile, multiplied by the ratios from curve sheet 15 for the different capacity of equipments, determined by curve sheet 14, will be proportional to the total energy required per mile.

From the various curve sheets the following table is deduced:

TABLE 5.

a	kw./ton	Wh./ton	ρ	ρ × wh./ton	
				Wh.	%
.5	7.6	106	1.87	198	174
1.	5.6	75	1.63	114	100
1.5	6.5	73	1.73	126	111
2 0	8.7	70	2.03	142	124
3.0	12.6	67	2.65	177	156

The last column of this table shows the energy required per mile to be the minimum for an acceleration of 1 mph./sec.; the motor capacity is also at a minimum for this acceleration.

To take the case of the proposed express service of the New York Rapid Transit Line: Here the schedule speed will be 35 mph.; the average distance between stations about 7500 ft.; time of stop at stations, 15 seconds.

From these data,

$$V = 38.8 \text{ mph.}$$

and $A = .275$.

The following table is deduced from these data:

TABLE 6.

a	kw./ton	wh./ton
1.	16.7	102
1.5	14 9	82
2.	18.8	72
3.	26.9	62

This table shows the practical impossibility of accomplishing such a schedule on the assumptions of this discussion. The minimum motor capacity required of 14.9 kw/ton is beyond the range of practical conditions. The weight of motors, controllers and wiring—that is, the electrical equipment alone—will be about 75 lbs. per kilowatt, and the weight for 14.9 kw would be about 1140 lbs. This does not leave sufficient weight for the other parts of the equipment. For an acceleration of 3 mph./sec. the weight of the motors required, 26.9 kw., would be approximately one ton; that is to say, at this initial acceleration the motors would just be able to propel themselves.

Conclusions.—My conclusion from this discussion is that the acceleration that gives the lowest motor capacity per ton is in all practical cases the most economical. The very small saving in energy is not to be compared with the many disadvantages of very rapid initial accelerations. Assume, for instance, a gain of 10 watt-hours per on mile for an acceleration of 3, over that required for an acceleration of one; for a 20-ton car, and with energy at .5 cents per kilowatt hour, this represents a saving of .1 cent per car-mile. This is too trifling to be considered in comparison with the fixed charges on the greater investment for motors and distribution system; the poorer load factor at the power station, the increased cost of maintenance, the difficulty of accurate handling of cars, and, above all, the much greater discomfort to passengers.

Although I have had to make, in the course of this discussion, various more or less arbitrary assumptions, I believe that they are all fair ones, representing average conditions. It is open to any one to follow this method on such other assumptions as may suit his fancy. I believe, however, that no practical assumptions will change the general results.

Statistics on Electric Railway Locomotives

The accompanying table, which has been compiled by the engineers of the General Electric Company, presents for the first time in tabular form the principal dimensions and data on the electric locomotives built by that company. This list comprises most of the different types of the electric locomotives in use in this country, as well as a number abroad, but is exclusive of motor cars.

Of the latter there are, of course, a great many in use, but the following statistics of some of the larger motor cars in operation may be of interest:

LOCOMOTIVE CARS

New York, New Haven & Hartford Railway (Nantasket Beach).
- Locomotive cars are the standard passenger coach type, both open and closed, some two and four-motor equipments.
- Two (or four) G. E.-55, one turn, 500-volt motors.
- 300 (or 600) hp per car.
- Controller, L-2, one on each platform.
- Air pump, direct connected.
- Current collection, trolley and third rail.
- Maximum speed, 40 miles per hour.
- Weight, 40 tons loaded.

New Britain & Hartford Branch.
- Locomotive cars, standard passenger coach type, closed, with two-motor equipments.
- Motors, two G. E.-55, one turn, 500-volt (150-hp).
- Controller, L-2, one on each platform.
- Air Pump, direct connected.
- Weight, 35 tons loaded.
- Current collection, third rail.
- Maximum speed, 35 miles per hour.

Brooklyn Bridge.
- Cars of the closed passenger coach type, with two-motor equipments.
- Motors, 4 G. E.-50 (80-hp each).
- Controller, K-14, one on each platform.
- Air pump, direct connected.
- Current collection, third rail.

Metropolitan Elevated Railway, Chicago.
- Locomotive cars same general type as before mentioned, some four-motor equipments, with 4 G. E.-2000 motors (135 hp each), same with two G. E.-55 motors (150-hp each).
- Controller, L-2.
- Air pump, direct connected.

Lake Street Elevated.
- Similar to above, with two G. E.-55 motors (150-hp each).
- Cars on the Metropolitan West Side and Lake Street Elevated all haul three trailers each at a schedule speed of 14 miles per hour, and a maximum speed of 26 miles per hour.

The New York, New Haven & Hartford Railroad intends to equip its extensive shops at Readville, Mass., with electrically operated machinery. The contract for the electrical apparatus was let this week to the General Electric Company, of Schenectady, N. Y.

	Baltimore & Ohio Locomotive	Hoboken Shore Locomotive.*	Cuyadutta Locomotive	Buffalo & Lockport Locomotive	Paris-Orleans Locomotive	Central London Locomotive	Milan-Gallarate Locomotive	St. Louis & Belleville Locomotive
	Heavy Freight and Passenger Service	Switching and Freight Haulage Service	Passenger and Freight Service	Freight Haulage Service	Passenger Service	Underground Passenger Service	Sample and Testing Service	Freight Haulage Service
Weight	96 tons	28 tons	35 tons	38 tons	50 tons	48 tons	37 tons	50 tons
Gage	4' 8½"	4' 8½"	4' 8½"	4' 8½"	4' 8½"	4' 8½"	4' 8½"	4' 8½"
Length (over all)	38' 6"	29'	29' 2"	29' 7½"	34'	30' 3"	33' 3¼"	32' 4¾"
Height	14' 3"	13'	11' 10"	10' 6"	12' 5"	9' 4½"	14' 3⅜"	12' 2½"
Width	9' 6¼"	8'	7' 10¼"	8'	9' 3"	8' 3¾"	8' 3"	8' 8½"
Wheel base (rigid)	6' 10"	5' 6"	6'	6'	7' 10"	5' 8"	6' 10"	6'
Wheel base, total	23' 2¼"	18' 2"	18' 9"	....	23' 10"	20' 4"	21' 4"	20' 6"
Motors, No. on each loco.	4 500 V.	4 500 V.	4 500 V.	4 500 V. (2 in series)	4 500 V.	4 500 V. gearless	4 500 V.	4 500 V.
Motors, type	A. X. B.-70-1-turn	G. E. 2000-1-turn	L. W. P.-200	G. E.-55-1-turn	G. E.-65-1-turn	G. E.-56-1-turn	G. E.-55-1-turn	G. E.-55-2-turn
Controller	L.-10	L.-2	Special S. P.	K.-24	L.-7	L.-6	L.-7	L.-3
Diameter of wheels	62"	40"	40"	36"	49"	42"	42"	33"
Journals	7" x 11¾"	4½" x 8"	4½" x 8"	4¼" x 8⅜"	6¼" x 10"	5½" x 10½"	4¼" x 8"	4¼" x 8⅜"
D. B. pull (rated)	42,000 lbs.	10,000 lbs.	8400 lbs.	12,000 lbs.	16,250 lbs.	12,000 lbs.	12,500 lbs.	16 250 lbs.
Maximum speed (light)	60 M. P. H.	8 M. P. H.	25 M. P. H.	9.85 M. P. H.	15 M. P. H.	40 M. P. H.	26.7 M. P. H.	7.6
Gear reduction	1:1 gearless motors	54:17	3.41:1	52:21	78:19	1:1 gearless	56:17	56:17
Current collection	Third rail	Trolley	Two standard trolleys	Pneumatically controlled trolley	Third rail and trolley	Third rail	Pneumatically controlled trolley	Trolley
Air pump	O. C.	I.B. gear. air pump	O. C.	C. P.-10	C. P.-10	C. P.-10	C. P.-10	C. P.-12
No. of P. R. boxes	48 (special)	12	18	....	30	30	30	30
Height of platform	....	....	4' 0¾"	3' 8"	....	....	4' 4"	....
Speed curve	....	....	....	....	....	....	....	C 1885

* Has hauled 225-ton train up 1.12 per cent grade at 6 M. P. H. at 500 volts.

Further Letters on Non-Combustible Cars

New York, Jan. 19, 1902.

To the Editor of the New York *Times:*

The public is to be congratulated that George Westinghouse's letter, published in yours of the 16th, happened among others in a medium that would grant the subject the space its agitation warrants.

At so critical a period of the Park Avenue tunnel history, and when the abatement of the nuisance suffered so long seems more probable than at any previous time, it would have been a misfortune had sentiments from so ostensible an authority as Mr. Westinghouse been voiced and not received promptly intelligent criticism and refutation.

By probable abatement I refer not particularly to the New York Central's proposed limited scheme of electrical equipment in the tunnel, but to the likely outcome from the city and State's investigation of the awful catastrophe with which we are all too familiar.

The *Times* has long championed, Park Avenue property owners and the traveling public have long worked for, and the railroad officials themselves have long been cognizant of the feasibility and advantages of electric propulsion in that tunnel.

The denunciation in public prints and otherwise of the railroad company has been almost unanimous in attributing the present intolerable condition of affairs to parsimony. For my part, I would attribute it to a weakness, for which, among railroad men, the Central's management has always been censured, viz.: lack of aggressiveness.

Whether it be steam heating of cars, the installation of block signals, or the renovation of a medieval station, the New York Central is always aggravatingly delinquent, never a leader.

The interests with which George Westinghouse is prominently identified gain for any remarks he may choose to make more than ordinary credulence. Investigation, however, will elicit that, contrary to assumption, his proffered advice on various occasions has been analogous to the New York Central's management's policy. When the elevated railroads of Chicago commenced to operate electrically the Manhattan officials sought the talent of the day for conference. On George Westinghouse's advice to "stick to steam," electrical equipment was postponed here until decreased receipts and the success of the Chicago project made it manifest that there was no other recourse.

Mr. Franklin's testimony (you will find his official title in the report of the testimony published in the *Times*) so far before the Coroner's inquest leaves not an iota for dispute that the steam and smoke in the Park Avenue tunnel daily places in jeopardy the lives and limbs of the great army that travel therethrough. This consideration alone is sufficient to warrant summary action on the part of the authorities, and no such advice as Mr. Westinghouse's should be admitted to afford the railroad company an opportunity to cavil. As has been repeatedly stated, no engineering difficulties exist which would preclude even a semi-aggressive management from undertaking the required improvement. To wait for the development and perfection of metallic passenger coaches would be well-nigh criminal in the light of what has transpired.

As to the bogy of short-circuits from accidents and resultant conflagration, I have in mind now three accidents of derailment and one of rear-end collision, all on elevated structures, utilizing the third rail, each of which resulted as such an accident is certain to result, Mr. Westinghouse's assertions to the contrary, notwithstanding—in the opening of the circuit breaker at the power house, rendering that section of the road electrically dead. If time allowed, I could point out where one of the companies bearing Mr. Westinghouse's name has advertised to supply precisely such a device, eulogizing its absolute positiveness.

Mr. Westinghouse would do well to take a ride through the section of the Fourth Avenue tunnel below Forty-Second Street, where electric cars run at high speeds during rush hours on twenty seconds' headway. All the advantages of a properly equipped tunnel are here manifest. I know of no accidents having occurred in this piece of ideal subway.

In closing, I beg to invite even those who know naught of the technicalities dealt in to contemplate the environment of an electrically driven, lighted and heated train in an electrically lighted tunnel, with atmosphere fresh and breathable, and then compare with this combination a train drawn by a steam locomotive, heated by steam, lighted by gas, in a tunnel filled with noxious lurid fumes.

Is it not a hallucination to even intimate that the latter equipment, whether in time of normal operation or at a moment of dreadful impact, is preferable to the former? Is it not at this time an affront on the long-suffering public of New York and those who visit us?

Ray D. Lillibridge.

Brookline, Mass., Jan. 18, 1902.

To the Editor of the New York *Times:*

The letter of Mr. Westinghouse in your issue of Jan. 16 sounds a bit startling, and seems to the writer somewhat overdrawn, but it certainly gives a note of warning that should not pass unheeded. In the rapid development of electric traction there has been a tendency to take chances which from the standpoint of public safety should be suppressed. I do not think it too much to say that, on the whole, electric motive power is the safest means of propulsion yet devised, above, on, or under the surface of the ground, but it is not without certain dangers, preventable, but not to be neglected.

With a properly arranged system there should be little or no danger from fire, but a live working conductor at 600 or 700 volts, with 10,000 hp or so back of it, is a thing to be treated with respect—more respect, I am bound to say, than is usually accorded it. An unguarded third rail carrying a current at the voltage mentioned may very easily give a fatal shock or cause a disastrous fire, and is by no means a safe method of supplying energy. Here in Boston such a system is in use on the elevated railroad, and has already occasioned several deaths from shock and divers interesting pyrotechnic displays that failed of causing fires only by good fortune. A proper system of insulating and guarding the third rail would, however, remove these dangers, and ought to be rigorously enforced, especially in the case of a tunnel, where if anything happens the passengers are caught like rats in a trap.

On the New York Central tunnel the first necessity is to abolish the smoke nuisance once for all, and there is no feasible way of doing it but by electric traction. No palliative measures can have any considerable value, and it is almost a waste of time to attempt them. The electrical problem may be divided into two distinct parts. First, the tracks below 125th Street should be absolutely rid of steam locomotives and electric traction should take its place. It is a perfectly easy matter to construct electric locomotives big enough to take the trains through the tunnel at schedule speed, and the short time required to change engines is not a serious matter. Such locomotives have been in successful use in the Baltimore tunnel for the past five years. If the tracks below are permanently rid of steam locomotives, there will be a pure atmosphere and entire freedom from smoke in the tunnel, and such a catastrophe as the recent one should be quite out of the question. Electric trains so run are under as full control as any trains at a similar speed, and if necessary an absolute block system can be used so that a collision cannot occur for lack of motive power. Such a system would at least make the tunnel clean and vastly safer than now.

The second part of the problem brings upon the conversion of the suburban service to electric traction. If this were done motor trains would be used and would come through the tunnel without aid from separate locomotives, like electric trains on an elevated road. But this electric suburban service, albeit a very good thing, is not necessary to reform in the tunnel. Much of the difficulty of the whole problem disappears if the idea of using steam below 125th Street is dropped once for all and the whole track space devoted to electric traction. The question of arranging the working conductors is not an easy one, but it can be done with entire success and safety. If a third rail is used, however, it must be much more thoroughly safeguarded than has been the custom heretofore, or an element of danger of a rather serious kind will be introduced. In the light of present experience safety can be assured.

Louis Bell.

New York, Jan. 21, 1902.

To the Editor of the New York *Times:*

I believe there is not the slightest reason to doubt that, with a proper degree of foresight in design, reasonable care in installation, and systematic inspection and test after installation, electricity is a safer agent than steam in the operation of elevated or underground railways. That trolley cars now and then catch fire is undoubtedly true, but this is invariably a result of poor work in wiring, carelessness in placing resistance boxes in immediate proximity to unprotected woodwork, or similar causes. With the same degree of skill and care that is insisted on in the construction and inspection of steam locomotives these accidents would occur very rarely, if ever, and I have no doubt that it was with a view to pointing out the necessity of such skill and care that Mr. Westinghouse wrote his letter.

As regards fire resulting from collision in case of electrically propelled cars or trains, I have never heard of a single instance. It is not impossible that such a result should follow collision, but in my opinion the fire risk in such a case is far less than in cases where steam locomotives are used. When steam trains collide passengers are exposed to danger resulting from one or all of three sources, viz.: (1) The stored energy of the train which wrecks or damages the cars, (2) fire from the engine or the lighting apparatus, and (3) steam, which is commonly used to heat the cars.

When electric trains collide the energy of motion may cause wreck or damage, but the fire risk is greatly reduced and the steam risk is eliminated. I base my statement that the fire risk is reduced upon the fact that in the case of the electric train it is perfectly possible and not even difficult to absolutely cut off the supply of power to wires in the wreck within a fraction of a second by automatic circuit-breaking devices of types almost universally used in power houses and proved reliable by years of experience.

The use of open or exposed fuses, such as apparently caused the recent fire in Liverpool, should not be permitted, but automatic circuit breakers located in fireproof compartments, which may be constructed of iron if necessary, or properly enclosed fuses of several types, which are on the market and extensively used, practically eliminate the risk.

The public demands higher and still higher speeds, and this demand must be met. It should be met, however, conservatively and with due regard to every reasonable precaution that can insure the safety of the traveling public. If speeds are increased, brakes must be made correspondingly more powerful. I have little sympathy with that kind of electrical railway engineering which busies itself exclusively with the construction of theoretical speed curves, ignoring practical questions of railway operation the importance of which has been established by long years of experience, but I cannot agree with Mr. Westinghouse that in case of a wreck the risk of fire caused by resulting short-circuits is at all comparable with the risk of fire when a steam locomotive, carrying in its firebox from 1500 lbs. to 2000 lbs. of incandescent coals, plows its way through a car. If the current to each car be supplied through a proper automatic circuit-opening device, there is every reason to expect that the current will be cut off before a fire is started.

If, in addition to this, as for example in the case of the Manhattan Railway Company, the third rail is divided into sections, each of which is supplied through an automatic circuit breaker located in the sub-station, it would seem that assurance is made doubly sure. Theoretically, of course, it is not impossible that both circuit breakers should fail to operate and that a fire might result, but in my opinion the chances of such an occurrence are very remote.

In comparing the relative risks of the two systems of car propulsion in tunnels we may perhaps derive some light from a consideration of the probabilities in the case of the recent collision in the Park Avenue tunnel had electricity and not steam been in use as the motive power.

Unquestionably, as Mr. Westinghouse implies, it cannot be assumed that the accident would not have occurred, but had all trains passing through the tunnel been electrically equipped it is at least certain that there could now be no question as to the inability of the engineer to see his signals by reason of smoke.

Had electricity been used, the total weight of the Harlem River train, if equipped with motors capable of doing the same work as the engine, would have been materially less and the energy of impact correspondingly decreased. The forward cars of the Harlem River train, not being protected by a heavy engine in front of them, would probably have suffered more damage than they did under the actual circumstances, but on the other hand it seems reasonable to suppose that the last car of the New Haven train and its passengers would have fared far better than they did when the massive engine with its load of steam, hot water and live coals plowed its way through the car.

Had electricity been used, there would have been no scalding steam to burst forth from broken steam pipes to drive away rescuers and, as actually happened in this instance, destroy some lives that might otherwise have been saved.

As regards fire, I believe it is a fact that the wreck in the Park Avenue tunnel was ignited by the engine, although the flames were promptly extinguished. Had electricity been used, there is every reason to believe that while short-circuits in the car wiring might have resulted, the current would have been cut off so promptly by the automatic circuit breakers that the wreck would not have caught fire. As a matter of fact, the trolley car fires which occur now and then rarely, if ever, happen at the time of or as a result of a wreck. They arise chiefly from inadequate or careless car wiring and can be practically eliminated by a reasonable degree of care in mounting the motors and controllers, the use of a proper grade of insulation, and a system of regular and adequate inspection and test. At least 90 per cent of the trolley cars which have been burned in service would never have caught fire had they received one-half the care which is insisted on in the case of steam locomotives.

L. B. Stillwell.

ELECTRICITY FOR THE NEW YORK TUNNEL

BY FRANK J. SPRAGUE.

(From the Electrical World and Engineer for Feb. 1. 1902)

I note that *Electrical World and Engineer* has published in its issue of Jan. 25 the recent letter of Mr. Westinghouse on electric traction and safe care for the New York Central Railroad, my reply thereto, and his second letter, his correspondence having appeared in the New York *Times*. I feel, however, that the second letter from Mr. Westinghouse and the facts in the case require further consideration at my hands, and I take advantage of the hospitality of these columns to defend once more what I deem the best interests of the electric traction art, including those with which I happen to be more or less identified as their exponent. Mr. Westinghouse, moreover, has no monopoly of public concern. The necessity of doing everything possible to avoid the dangers of fire in a car propelled electrically or otherwise is apparent to all, and would naturally command support even if recommended by less eminent authority. So, too, with all practical proposals for increasing the structural strength of cars, reducing the liability of crushing and telescoping in a collision, and improving brakes and signals. But the electrical and the transportation world must not be thrown into a panic, and stampeded into paralysis because some particular method of car construction is not found in all existing rolling stock, and because all the possible improvements permitted in new work cannot be universally applied. The simple fact is that Mr. Westinghouse, moreover, has no monopoly of public concern. New York Central tunnel practically asserted that the present problem cannot be solved electrically, because the method which he assumes will be recommended is that of motors distributed under the cars, and, the existing cars being combustible, this is dangerous, and hence such a plan must not be considered. All alternative or composite schemes are entirely ignored.

Whatever the detail plans which the New York Central may have under advisement, and as to this my guess is probably as near correct as that of any other outsider, which guess is that Mr. Westinghouse is very much in error, I have not the slightest hesitation in saying that every train movement in the tunnel and at the Grand Central terminus can be efficiently, promptly and safely made under electrical operation. And if it be true, which I do not think it is, that no electric manufacturer would undertake such a contract, then it is proper to say that there are contracting and constructing engineers who would not hesitate to assume the task, and Mr. Westinghouse's disinterestedness is not sufficient to make him refuse to supply any needed apparatus of his manufacture which might be found suitable. He should not speak of inventors and manufacturers in terms of suggested disparagement because his particular pride has long been to be a shining light among those classes.

The real problems before the Central management are not alone operative ones, intensified by limited track room, lack of storage space, and consequent congestion of movement, but also those of civil engineering. The proposal to loop the suburban tracks, no matter how the trains are operated, is commendable in the highest degree. But it is certain that such a loop will be operated electrically, and the natural corollary is that the electrical operation will ultimately be carried beyond the limits of the tunnel, at least as the normal operation of these trains, in which case multiple-unit operation, possibly with cars of new construction, will most likely be adopted.

Another problem is the handling of existing trains undisturbed in make-up or equipment, hauled to some point within reasonable radius of the Grand Central station by steam. It is clear that for this terminal work the motors will not be distributed under passenger cars.

It is reported that Mr. Yerkes intends to introduce on the Metropolitan District Railway, of London, an improved type of car. I doubt not that this is so, and that it will be made just as strong and as free from the possibilities of damage by collision and by fire as it is practical to make it, that steel construction for at least the under body of the car will be adopted, but more for structural purposes than because of electrical dangers. In this connection it is proper to point out that most modern cars on the Continent of Europe are so built to-day, and the cars on the Versailles division of the Western Railway of France, operated on the multiple-unit plan, are constructed in this fashion. It is also likely that some parts of the upper structure may be made of steel, and other parts of wood or other material treated so as to be non-inflammable, the same as is now required on modern battleships.

The ordinary possibilities of fire on an electric car may briefly be summarized under three heads: Flashing at the contact shoes, which, being carried on an all-steel truck, may be now discounted; breaking of connections or chafing of wires extending from the motors on the truck to the controlling apparatus on a car, caused by frequent and extreme movements of pivoted trucks, which can be avoided largely by good construction, and so far as the car is concerned by proper sheathing, and the making and breaking of current in the main motor controllers. Special insulation is essential in the running of circuits, and it must be provided either naturally in the car construction or by special precautions, whether the car be of wood or steel, more in the latter case. It goes almost without saying that the controlling apparatus itself may, and should, be so constructed that no matter what the internal trouble, or what the amount of arcing due to bad or misplaced contacts, the disturbance shall be entirely local, and shall be kept so by being enclosed in an iron-clad structure.

Common sense and prudence then indicate that whatever improvements in car construction may be introduced in the progress of the art, the first essential is to make the apparatus itself which controls motors reliable and fireproof, and then to protect its installation and the installation of the motor equipment by the best methods known to the art to-day. It is safe to say that when this precaution is taken, the operation of the electrical train is amply safe, Mr. Westinghouse to the contrary notwithstanding. The presence of wood of itself is oftentimes a matter of safety, rather than danger, in electrical construction, because when properly protected it is not only a good insulator, and, therefore, avoids one of the initial possibilities of electrical trouble, but, properly sheathed with fireproof material, the risk from its use is reduced to a minimum. On account of the use of the grounded circuit, the presence of steel renders less possible the absolute isolation of different parts of the electrical equipment, and can introduce possibilities of trouble which are foreign to some other construction.

Mr. Westinghouse must find himself in a somewhat embarrassing position, to illustrate which I may refer to a bit of recent history. He states unequivocally that any use of motors under care of present construction on elevated trains or in a tunnel is reprehensible and dangerous. If this be his present contention, in what light does he stand before the management of the Brooklyn Elevated Railway, where, in 1898, he began applying motors under the existing cars. On this road, which, so far as electrically equipped, is operated strictly on the multiple-unit plan, there have been three classes of apparatus used, some being of Westinghouse make. Notwithstanding the specific experience of over two years, despite all the changes which had been made and troubles which had been experienced, concerning which he could not be in ignorance, and notwithstanding the fact that the controllers had been taken from under the cars where they were inoperative, and installed inside the cars, the Westinghouse Company, undoubtedly under guarantees of safe and efficient operation, have within the past year made a contract for a number of equipments to be used under the regular cars, in competition with others, at prices and under conditions of payment and guarantees which no competitor would for one moment entertain, and which carry their own story, to do the very thing which Mr. Westinghouse himself now condemns. And this contract was supplemented by a proposal to equip the Manhattan Elevated Railway on the multiple-unit plan, using the existing cars. Should that collision and accompanying holocaust which he now freely predicts occur on the Brooklyn Elevated with cars equipped with his apparatus, in what contradictory and dangerous position will he and the Brooklyn Elevated Railway find themselves in view of his former protestations and his recent utterances.

Really, if all that is predicted is in any measure true, if it is impossible for all practical purposes to protect existing cars so that they may be safely operated electrically, then the 50,000 railway cars in this country would better be pitched into the scrap heap, the Manhattan, Brooklyn, Boston and Chicago elevated railways would better replace their wooden ties and do away with guardrails, or go back to steam, electrical science turn backward, and horses and the cable be restored to their former pre-eminence.

For State Authority to Secure Entrance to Cincinnati

There has been introduced in the Ohio State Senate a bill that has for its object the admission of interurban electric railway lines into Cincinnati. The bill in itself provides for the construction of common terminals in any city of the State that may be used by all traction lines desiring an entrance, and inasmuch as all other cities of Ohio, with the exception of Cincinnati, already have interurban lines entering their limits, the bill, if it becomes a law, will have a direct bearing on the situation in Cincinnati. It has been expected for some time that a bill having for its object the securing of State consent to enter Cincinnati would be introduced, but the bill that has found its way to the Senate, it would appear, is mild to what had been expected. Instead of being calculated to throw the city wide open, and tending to give the interurbans the right to run over any of the existing city lines, it is seen to be a bill that provides the legal machinery under which a company can incorporate for the purpose of building terminals that shall be utilized by all interurbans, and that shall be kept as distinct and as free from interference with the business of the existing street railway lines as is possible. No less than six companies are now desirous of obtaining entrance to Cincinnati.

Street Railways in New Hampshire

The annual report of the Railroad Commissioners of New Hampshire has recently been made public. The report refers to the growth of the industry throughout the entire country, and then confines itself solely to the advances that has been made in New Hampshire. The report says: At the beginning of the year 1892 there were in the State but 51 miles of street car track, of which 28 miles were operated by horse power and 21 miles by electricity. According to the returns on June 30 last, there was in the State a track mileage of 138.47 miles, capitalized at $1,498,000, in stock, and $1,486,744.76 in bonds. Since June 30 the Manchester road has been extended 2 miles at a cost of $27,000, the Portsmouth about 3 miles at a cost of about $45,000, and the Union, now the Dover, Somersworth & Rochester, about 13 miles, which, with power plant and park expenses, adds $400,000 to the capitalization of the new corporation. The Seabrooke & Hampton, 5 miles long, has been completed and is now in operation, as is 10 miles from the State line at Amesbury to South Hampton, Newton and from Plaistow, and there has also been built a road from Salem to Nashua, a distance of 14 miles, all of which will be capitalized at about $700,000. These expansions increase the mileage of the State to 135 miles, and the total capitalization to $4,288,934, an average of $23,000 per mile.

Of the proposed roads the report says: The Berlin Electric Railway Corporation has taken all the preliminary steps toward the construction of a road through the streets of Berlin, and to Gorham, a distance of 8 miles, at an estimated cost of $215,000. A road has been chartered from Newport to Sunapee, a distance of 7 miles, and the capital for the same has been secured. The Keene Electric has procured a charter for an extension from Keene to Swanzey, 6 miles in length, and proposes to open it early in the spring. The Exeter & Portsmouth Railway, 12 miles in length, has been chartered and capitalized, and the Haverhill & Manchester, 27 miles long, has been chartered and located. Both are promised in the near future by those in control of the franchises. The Boston & Maine has secured from the court a right to construct a line from Concord through the towns of Pembroke and Hooksett to Manchester, and from Manchester through the towns of Litchfield and Hudson to Nashua. The section between Concord and Manchester has been graded and will be completed and put in operation early next spring, and that between Manchester and Nashua is expected to materialize during the year. The length of these two branches will be about 30 miles.

The receipts of the roads in operation prior to June 30 were as follows: Chester & Derry, $12,248.56; Concord, $70,275.29; Exeter, Hampton & Amesbury, $105,298.50; Keene Electric, $16,246.82; Laconia, $24,877.76; Manchester, $212,138.11; Portsmouth, $53,628.02; Dover, $45,234.76; a total of $552,447.82. Only the rental, $12,000, of the Nashua road, which is leased, is included in the returns. All the roads showed a net profit except the Laconia. Combined, the divisible income was $96,612.08 or about 6½ per cent upon the outstanding stock.

Park Attractions

F. Pincus, of Philadelphia, who has made a great success in the supplying of vaudeville and other entertainments for street railway parks throughout Pennsylvania, New Jersey and Delaware for the last four years, announces that he has made an arrangement with Henry Pincus, of the Vaudeville Association of New York, by which he is enabled to greatly increase the territory which he can supply with park entertainments. He is now in a position to supply troupes for this service to street railway parks in New York State, New England and the South and West.

On Jan. 16, according to a London despatch, a locomotive on the South London tube railway caught fire, owing to defective insulation. The fire spread to the sleepers on the roadbed, but as it was near a station it was soon extinguished.

Some Handsome Interurban Cars

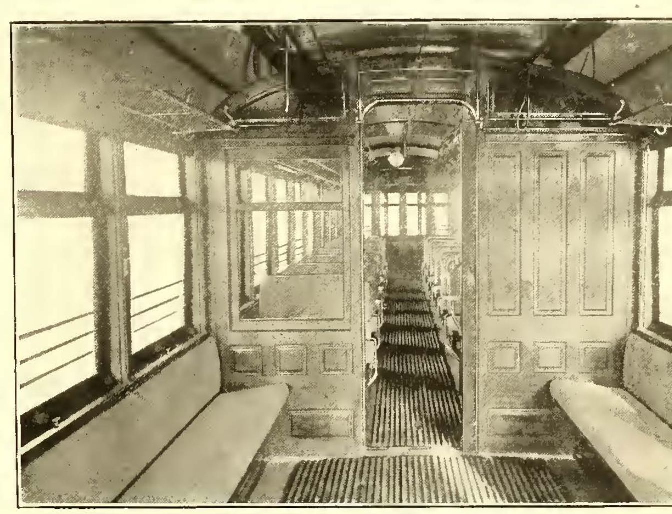
The John Stephenson Company, of Elizabeth, N. J., is building a large number of electric cars for interurban service. The accompanying illustrations show some of these cars, which have recently left the shops, and which contain a great number of interesting features. The necessities of interurban work have compelled many of the roads which operate this class of service to approximate in their rolling stock the facilities offered by the steam railroad train, and the designs of the John Stephenson Company have proved most satisfactory.

LONG CAR FOR SCHENECTADY-ALBANY LINE

The handsome car illustrated, which is to be sent to the Pittsburgh, McKeesport & Connellsville Railway Company, is one of an order of twenty-five. These cars are nearly all completed and will, it is expected, be soon in operation. The cars are made with steam coach roof continued out over the vestibule as shown, and have straight sides and ends. The width of the car is 8 ft. 4 ins., and that of the vestibule 7 ft. At the end of the car, therefore, a small space is left between the side of the car and that of the vestibule, which is provided with a small, narrow window. There are also windows at the side of the end doors, which are double. All windows are of plate glass. Both the doors and the windows inside of the vestibules are fitted with roller curtains, those on the doors having the roller vertical so that the mere act of closing the door unrolls the curtain. The motorman in his vestibule, therefore, is shielded from all light from within the car, and his view of the track is not obstructed by reflections from the front glass of the vestibule. The cars are 32 ft. over corner posts, the vestibules being about 5 ft. long. The interior of the cars are divided into two compartments, one of which is about twice the size of the other. The smaller compartment is used as a smoking compartment. Along the sides of the car, above the windows, are placed baggage racks for the convenience of passengers, and push buttons connected with bells on the platforms are inserted in the window posts. The car is lighted by incandescent lamps suspended from the lower deck of the roof. The seats are of the well-known "walkover" type, made by Hale & Kilburn, the seating capacity of the car being forty-four passengers. As the cars are expected to be used over long distances, a toilet compartment is included. This is placed at the partition between the smoking compartment and the main compartment, as shown in the plan. The total height of the car is 12 ft. 2 ins., and the bottom of the side sill is 3 ft. above the rail. Two steps are provided at each corner, fitted with the Universal safety tread.

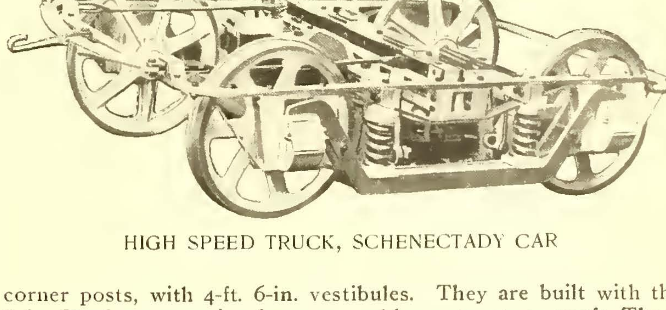
INTERIOR OF SCHENECTADY CAR

Another order for cars of a similar type to those above described has been received from the Hamilton, Glendale & Cincinnati Railway Company. The cars are the same in general external appearance, but have no toilet compartment. The specifications call for the Baker hot-water heater, which is being installed.



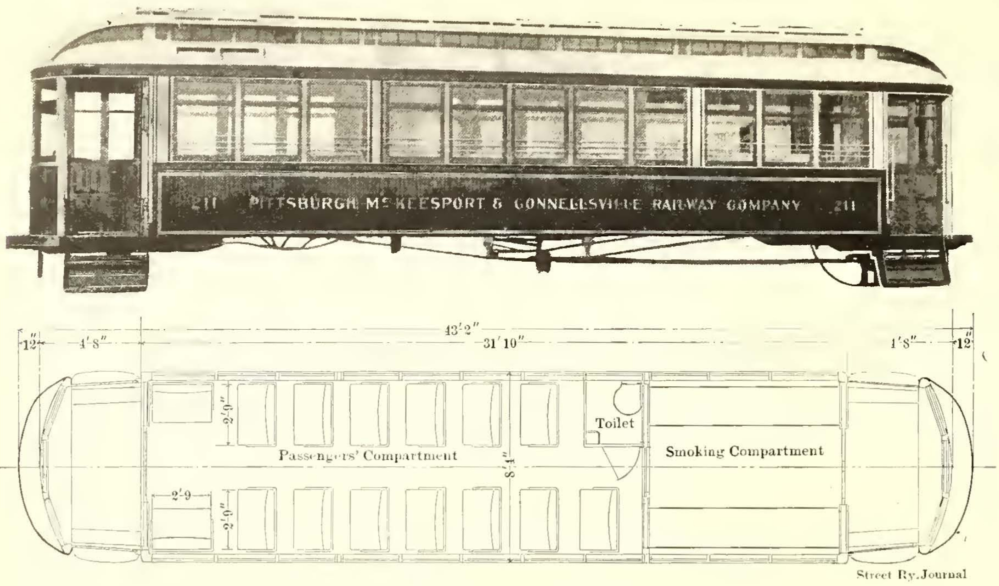
INTERIOR OF PITTSBURGH CAR

Another order for this type of car has been recently filled for the Schenectady-Albany line, and all the cars delivered. These are of the same general, straight-sided type, 36 ft. 2 ins. over corner posts, with 4-ft. 6-in. vestibules. They are built with the John Stephenson spring bumper, and have steam-car roofs. These cars have arc headlights, made detachable, so that one headlight is sufficient for each car, being moved from end to end when the direction of the car is changed. They are provided with two trolley poles, one at each end, as are all these long interurban cars. Trolley catchers made by the New Haven Car Register Com-



HIGH SPEED TRUCK, SCHENECTADY CAR

pany are placed on the outside of the vestibule. The finish of these cars is mahogany, inlaid in very handsome manner and highly polished, giving a very rich appearance to the car. These cars are mounted on the John Stephenson No. 6 trucks, illustrated herewith. This type of truck is especially intended for high-speed work and has proved very satisfactory in interurban service.



CAR BODY AND PLAN OF INTERURBAN CAR

While built in the main on lines copied from the Master Car Builders' standard, certain modifications have been introduced to fit the requirements of electric roads. The frame is made of wrought iron and the springs and side bars are so arranged that the truck is low enough to go under one-step cars.

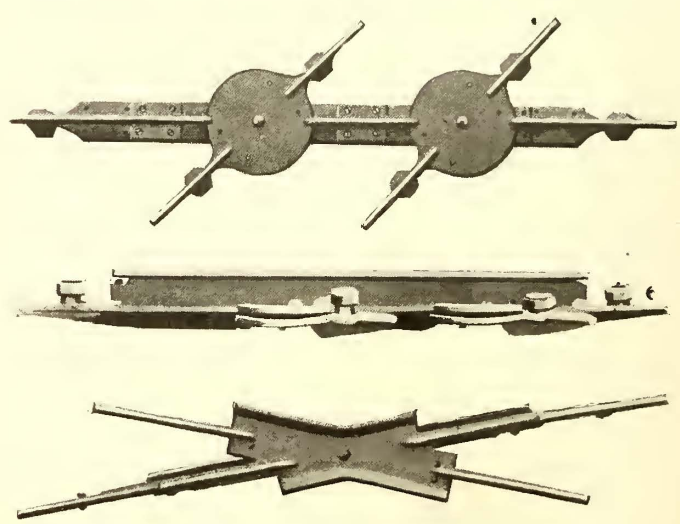
The above cars form an important addition to the rolling stock of American street railways. They have in common many details of construction which, although small in themselves, go a long way toward improving their appearance and serviceability. They are of the semi-convertible type, the window openings being sufficiently large to make a pleasant car in summer. The color of the Pittsburgh, McKeesport & Connellsville and the Hamilton, Glendale & Cincinnati cars are a dark green, which not only gives a very rich appearance to the car when new, but possesses most excellent wearing qualities. The grab handles at the vestibules are maple rods, highly polished and set in brass sockets at each end. This bit of light color at the vestibules has a very pleasing effect on the eye. The window openings are made extra large, a small sash raising into the roof being used above the main one. The lower sash are opened by dropping into sill opening and covered with hinged casing. The doors are fitted with "anti-rattlers." At the sides are placed rubber rollers, which effectually prevent the vibration of the doors, and a further precaution is taken by placing a strip of rubber in the guides where the two doors come together.

Electrical Repairing

The rapid development of street railways in the United States has created a demand for a new class of repair shops. While all operating roads have facilities for making nearly all of the ordinary repairs which are necessary under normal conditions, there are often times when these facilities are stretched beyond their limit and it becomes necessary to find some reliable firm to which the apparatus of the company can be intrusted. On the other hand, there are many parts of the electrical equipment which it is inconvenient and unnecessarily expensive to manufacture by the road itself, such as armature coils, field coils and many other details. The reliability of this part of the apparatus is of the utmost importance, as all railway engineers know, and if obtained from an irresponsible source it invariably leads to trouble. Among the recent firms which have been added to this class of the repair business is that of the Charles G. Hose Electric Company, of New York City, which has opened a large repair shop for the express purpose of attending to the wants of all users of electric machinery making a specialty of street railway apparatus. The president of the company, Charles G. Hose, has had large experience in this work, having been connected with the Brooklyn Rapid Transit Company for the past eight years in various capacities in the large repair shops of the company at Fifty-Second Street and Second Avenue, Brooklyn. The familiarity of Mr. Hose with all kinds of street railway apparatus from the practical side is supplemented by considerable business ability, and this, combined with the exceptional facilities possessed by the company, its machinery and operating force, have all resulted in a large amount of business. Mr. Hose has taken up a branch of the street railway business which is of great importance, and which is seldom made a specialty by concerns of this kind; this is the manufacture of car wiring cables made in any size or style desired, with the ends of the wires carefully tagged and the cables thoroughly tested before leaving the shop. The tags are made of copper, and are so fastened around the ends of the various wires of which the cable is built up that they cannot work loose, and are always in readiness for inspection. While the company expects that a large portion of its business will naturally come from roads at no very great distance from the Metropolitan district, yet it has facilities for receiving equipments for repair from roads at greater distances, and, of course, its repair parts can be sent to any part of the country where they are desired. The expenses of shipping the motor to New York for repair may be found to be more than balanced by the excellent workmanship and the cheapness of the repairing price. All kinds of work will be done, including the repairs on car controllers, commutators, generators, both alternating and direct current, and street railway and other motors, besides contracts for the complete wiring of car houses, offices and other buildings.

New Insulated Crossings at Richmond

In the accompanying cuts are shown two styles of overhead insulated cross-over switches designed by the superintendent of construction, H. S. Kemp, of the Richmond Passenger & Power Company, of Richmond Va.



FIGS. 1, 2 AND 3.—INSULATED TROLLEY CROSSINGS

Richmond, which is noted for having the first commercial electric street railway line in this country, now has two street railway systems, the Richmond Passenger & Power Company and the Richmond Traction Company. Both companies have common trackage and operate on each other's tracks in several streets. On streets where common trackage was granted it was deemed advisable to put up two trolley wires, each company to furnish its own power and expense of maintenance.

As the trolley wires are supplied from different stations, and are consequently of different potentials, all switches and cross-overs have to be of special design and insulated.

Fig. 1 shows a twin adjustable insulated crossing, with one adjustable crossing insulated from the rest of the crossing. The adjustable crossing on the short end is connected with the main body of the switch. Fig. 2 is a side view of the same cross-over, and Fig. 3 is a 30-deg. acute angle cross-over used at turnouts. These cross-overs are made right and left-handed. Fig. 4 is a section of the twin adjustable insulated crossing, and shows the general construction adopted in all of these appliances. As will be noted, the metal and fibre parts are bolted to a wood backing. The latter is bird's-eye maple, which is first treated with paraffin and afterward painted with P. & B. paint. It will also be noticed

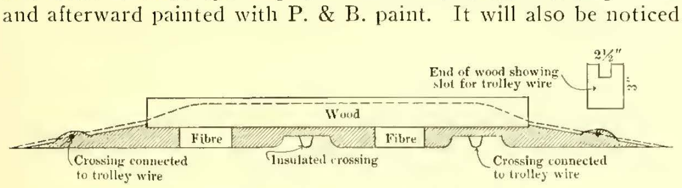


FIG 4.—SECTION OF CROSSING

that the switches and crossings are designed for a straight under run of the trolley wheel along the bottom surface of the switch, instead of making the contact parts belly down. One of the advantages claimed for this construction is that the motorman does not have to slow down to prevent the jumping of the trolley wheel. As the trolley wire is bent up and carried over the top of the switch, the latter is made extra strong to prevent buckling from the extra strain thus put upon it.

Some twenty of these cross-overs have been in use during the past year, with excellent results.

Cleanliness of Cars

Every street railway manager knows that the cleanliness of his cars is a paramount necessity, not only for the success of his road in attracting traffic, but also for preserving them, for dirt is a rapid agent in car deterioration. No matter whether the power station is operated at a most economical figure, the cars of the most recent design and manufacture, and the trucks of the most approved type, if the rolling stock is not clean the public will not patronize the road. Many preparations have been brought forward for cleansing cars, but none apepars to have met with such success as a material which is manufactured by Robert Young & Company, of Glasgow, and which is now being introduced into the United States by the Frank S. de Ronde Company, New York. This material is called "Sacarbolate," and so great has been its success in England that it is practically the only material used in Great Britain for cleansing cars. "Sacarbolate" is an antiseptic fluid soap which effectually cleans and renews all painted or varnish surfaces and leaves a most agreeable odor.

In using this material, the makers suggest that during dry weather, or when there is no mud on the painted woodwork, it is not necessary to do more than simply sponge over the parts with a very weak solution, but that in wet weather the soiled parts should be washed thoroughly every night.

The inside of the cars should be thoroughly washed once every two months, and should, in addition, be rubbed over daily with a sponge saturated in the fluid; further, once a week the floors under the seats should be carefully washed, using the full strength of the fluid. The floors also, after daily brushing, should be sprinkled with solution.

It will be found that the above treatment not only tends greatly to increase the life of the paint and varnish of the car, as well as of the car itself, but will keep it in a thoroughly fresh condition, and free from infectious germs. The acceptance of the agency in the United States for this material by the Frank S. de Ronde Company is an excellent indorsement of its merits.

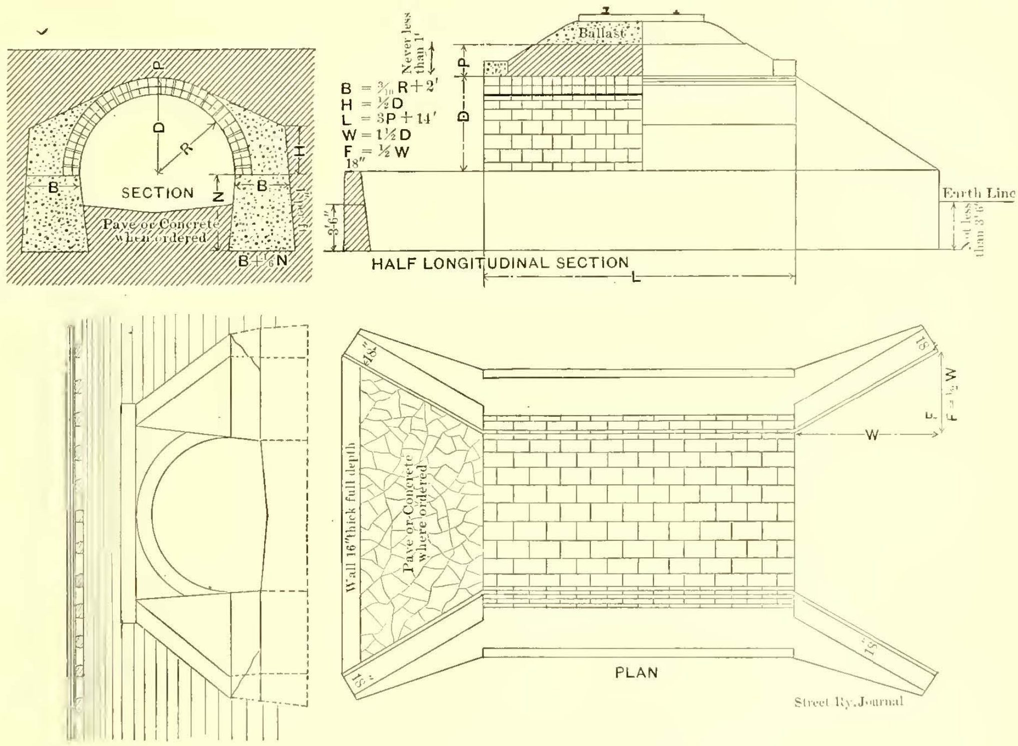
The Louisville Railway Relief Association

The report of the Louisville Railway Relief Association, composed of the employees of the Louisville Railway Company, of Louisville, Ky., for the year ending Dec. 31, 1901, has recently been issued. The association has steadily grown, both numerically and financially, since its organization, and is in a most prosperous condition. The total receipts of the association for the year were $2,788, of which amount $2,755 were received as dues, the remainder being interest. The sick benefit disbursements of the association amount to $1,377, while the death benefits reached a total of $600. The general expenses of the association were $327, making the total expenditures $2,305. On Jan. 1, 1901, the association had on hand a balance of $1,940, and this, added to the balance for the year ending Dec. 31, 1901, gives the association $2,423 with which to begin the new year.

Arch Culverts versus Girder Bridges

With the development of interurban railways throughout the United States the question as to whether to build girder bridges or arch culverts over the small streams or waterways is an important one. The girder bridge on good substantial and solid foundations with ties and rail just reaching the uniform and established grade is probably more generally in use, and is cheaper than the culvert, but it has certain disadvantages. One of these is that it remains the same as long as it lasts, and it does not settle with the road. The result is that when the road has been ballasted and settles away from the bridge, the roadbed must be brought up to a level with the bridge, and with more ballast, usually before the road has barely begun to earn money. This cost should properly be added to the cost of the girder bridge. On the other hand, the ballast can be put directly on the culvert.

The accompanying illustration shows a patent culvert, of which

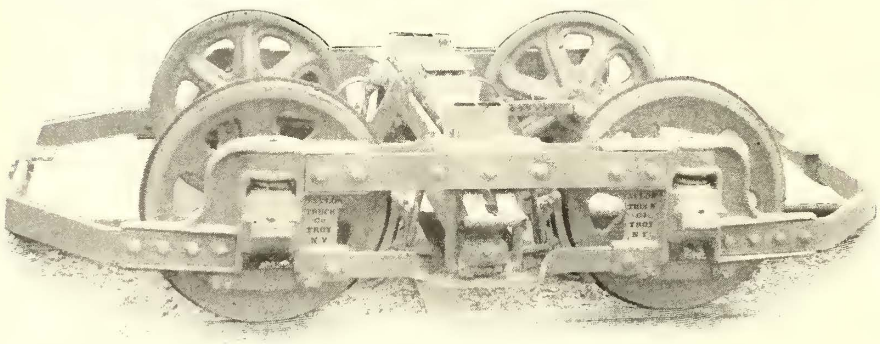


NEW TYPE OF CULVERTS FOR INTERURBAN ROADS

a number have been built for the Indianapolis & Martinsville Rapid Transit Company and other interurban roads by B. L. Blair, of Indianapolis, and which is of much interest in this connection. To many it will be something of an innovation, as it brings into new use the vitrified shales or clays. It is made of hollow vitrified blocks, the sides of which are parallel to the radii of the circle which they form in making the arch. They are laid in Portland cement mortar, 1 part to 2 parts, with the ends filled and protected. The blocks are made in thickness and depth to correspond to the size of the arch in which they are to be used. Tests made on these bricks at Purdue University by Professor Goss show that a block 8 ins. deep, 10 ins. wide and 12 ins. long would stand a pressure of 172,840 lbs. before showing signs of failure.

A New Type of Truck for Long Cars

The accompanying illustration shows a truck of novel design, which contains many interesting features. The truck has been recently perfected after a long experience with the necessities of the service for which it is intended, and it is confidently expected to meet the requirements of all work where a small wheel-base truck is required. It is of such dimensions and its parts are so arranged that it can be applied to long cars that are framed narrow on the sills, and yet accommodate itself to curves having short radii. The truck is built in two sizes, one having 33-in. wheels and a 4-ft. 6-in. base, the other having 30-in. wheels and a 4-ft. 3-in. base. A novelty of the truck is the swing motion of the bolster frame and the supporting elliptical springs. It is claimed that this is the only short wheel-base truck which combines these desirable properties. The elliptical springs from which the car body is supported rest against a beam, which is hung by the link shown in the engraving. The lower side-bar is twisted in the middle, so as to present a flat surface immediately below the end of this beam, and should the link break, therefore, the car body could only descend a short distance, and no further injury would be experienced by the truck or car body. The springs which support the car are constructed on the most improved principles as laid down by the standard practice of the Master Car Builders' Association. The brakes which are placed on the inside of the wheels are made extra strong, so that they can be operated by air or other automatic systems. They are of the live and dead-lever type, which has proved most reliable in service.

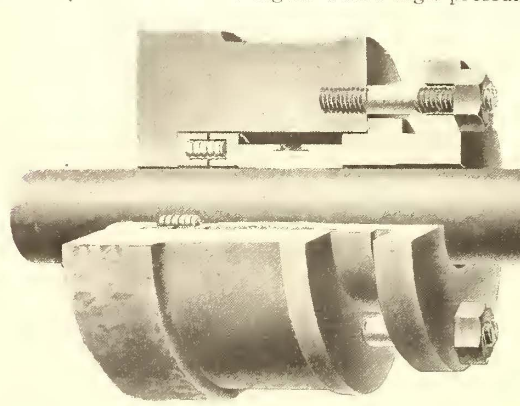


IMPROVED DOUBLE TRUCK

Both operating men and car builders will appreciate the advantage of having a short wheel-base truck which is applicable to narrow framed cars, and the manufacturers of the one illustrated think they have solved the problem. This design will be found especially useful on long double-truck cars which have become so essential in the economical operation of city railways, but it can be used with safety on high-speed interurban railroads as well. It is manufactured by the Taylor Electric Truck Company, of Troy, N. Y.

Metallic Packing for High-Pressure Steam Engines

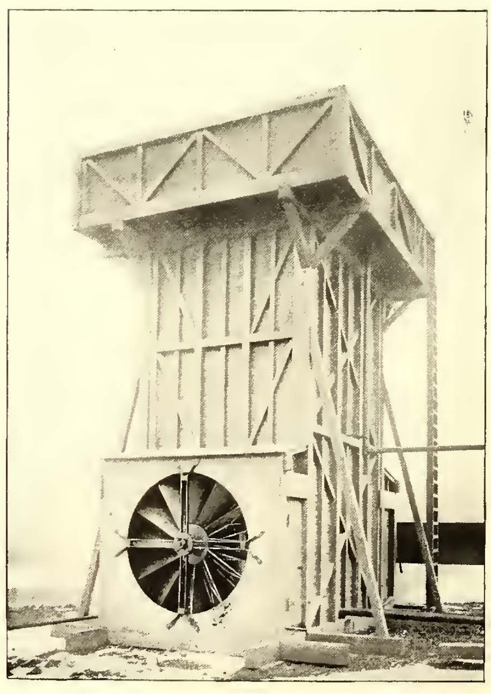
The advantages of a purely metallic packing for the piston-rods and other parts of a steam engine where high pressures are used has caused a number of styles to be placed on the market. One of the forms which has met with the greatest success is illustrated in the accompanying engraving. It is known as the Swain standard piston-rod packing, and is made by the Swain Lubricator Company, of Chicago, Ill. This packing has been used in varying and difficult positions for many years, and is made in several designs and forms, employing specific metals for specific purposes, and affording universal application to any build and use of engine or pump. Ample provision is made in the construction of these packings for vibration of rods and for rods running out of alignment. The packing rings consist of two sections. Each of the sections of one ring overlap those of the other, and are so doweled that they form a tightly jointed adjustable packing. These sectional rings are made of a special anti-friction metal encased in bronze, and are so strong and durable that they will not become broken under any ordinary conditions. Sufficient space is allowed in the recess above the ring to allow for any vibration of the rod or cage containing the packing rings. Double rings are placed at the inside of the packing, which contain between them spiral springs. These springs always press the packing rings tightly against the shaft, and hold the rings firmly together, so as not only to make a steam-tight joint between the packing ring and rod, but between themselves and the cage rings. The outside ring, which is forced against the box by the gland, has a small vulcabeston gasket on its inner face, making, together with the slipping joint between this ring and the packing rings, the escape of steam, air or gas, impossible. Besides the type of packing illustrated, a number of various styles have been perfected for special service, but the general advantages of the packing are shown in the type selected for the base of this article. Over 50,000 sets of this one form alone have been sold, and all of them have proven satisfactory in service.



AN EFFICIENT PISTON PACKING

The Stocker Cooling Towers

Although a few years ago cooling towers for supplying condensing water to steam plants not located near any natural body of water were seldom seen among large street railway power houses, their increasing use the past five years has made the sight of them more familiar than formerly. Their application, however, is by no means as universal as it is destined to be the next few years. Few steam plants, unless located where real estate is very high, can afford to do without the advantages and economy of running condensing. A form of cooling tower which has been used extensively in St. Louis and elsewhere is made under the patents of George J. Stocker, 2831 Victor Street, St. Louis, Mo. In external appearance it is as shown in the accompanying engraving, which is one of the standard Stocker towers. They are also made of steel or brick, as the customer may desire.



IMPROVED COOLING TOWER

The water is pumped to the top as in all cooling towers, and trickles down over the cooling surfaces, which are made up of boards in horizontal layers, set at right angles to each other, and provided between their intersections with upright oblique partitions. The fan blowers at the base are mounted in ring oiling, self-adjusting bearings. Two fans are used, instead of one, as is usual, and by this it is claimed a better circulation of air is obtained to a given amount of power and size of tower, because the air is more equally distributed throughout the tower. The water is distributed at the top of the tower by a system of funnel-shaped troughs of galvanized iron, so constructed that the water flow is evenly distributed over the cooling surfaces. These troughs, it is claimed, are not so likely to become clogged by the sediment of impure water as are perforated pipes, and the troughs are easy to clean.

The gallery around the top of the tower serves the double purpose of making the distributing apparatus easily accessible for inspection and cleaning and preventing possible splashing and blowing of the water over the walls of the tower. The basin underneath the tower in which the cooled water gathers, and from which it is led to the condensers, is, according to the location of the tower, built either of concrete or brick, or is a steel pan. In both instances, the construction must be such that the impurities will have a chance to settle out. The Stocker tower is claimed to be of much lighter weight than other designs of tower, and hence can be sometimes set up on a roof close to the condensers, rather than some distance away. The material put into these towers is carefully selected, the interior being first-class cypress, a wood of great lasting qualities under water. The use of wood for a cooling surface and the peculiar arrangement of boards gives a large cooling capacity in proportion to the weight and size of the tower. The power required to pump water the height of the tower is given as less than ½ hp per 100,000 gallons per day. The power required for the fans, of course, varies, but under some favorable conditions, the necessary cooling effect is obtained without fans.

An Improved Heater for Street Cars.

The New Century Car Heater Company claims a large number of been perfected by the New Century Car Heater Company, of Jersey City, N. J. This device is built along the same lines as the ordinary hot-air furnace, and contains the same elements of safety, economy and cleanliness that are found with apparatus using these principles for the heating of houses. The manner in which the principles are adapted to use on a street car are very original, and

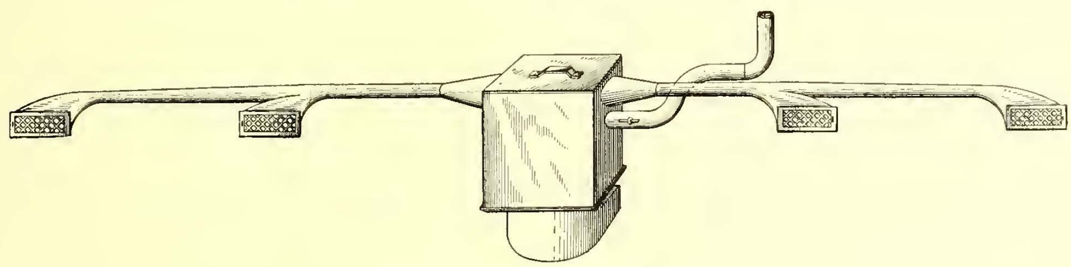


FIG. 1.—HOT AIR CAR HEATING SYSTEM

are well illustrated by the cuts. Fig. 1 shows the complete apparatus as it is installed under the seat of the car. The openings by which the hot air is expelled into the car body are placed in the

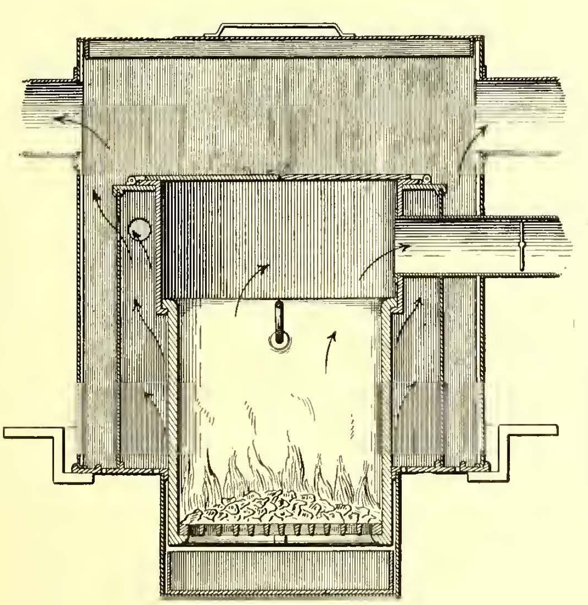


FIG. 2.—DETAILS OF FURNACE

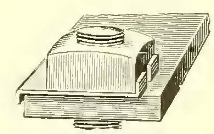
riser panels of the seats, and have the same appearance as the ordinary electric heater. On account of the rapid circulation of the air it is claimed to be impossible for these to assume a dangerously high temperature, but the almost unlimited supply of heat in the fire-box keeps the atmosphere of the car evenly heated. Only one heater is used in a car, it being placed under one of the seats and occupying none of the passenger space.

In the second illustration the details of the furnace are shown. The fire is contained in what is known as the fire-pot, which consists of an iron pot having a grate at its bottom and being provided with a handle, by means of which it is readily removed from the apparatus. This pot is filled with coal and the fire started before it is placed in the car, and in the same way when the car is taken out of service at the end of a run, the fire-pot is removed before the car enters the car house. This adds greatly to the safety, as no fire is taken into the buildings of the company. Above the fire-pot when in position are two chambers. The first is connected to the smoke pipe, which runs to the roof of the car, and is closed by two hinged doors, which overlap and make a tight enclosure. The second chamber is the top of the hot-air space, and opens on each side to the conducting flues, which lead the hot air to the registers in the seat panels. All the air which reaches this chamber is brought up by the side of the hot fire-pot, and is evenly and thoroughly heated thereby.

The New Century Car Heater Company claim a large number of advantages for this device. The furnishing of fresh air to the interior of the car greatly increases the comfort of the passengers, and the easy regulation of the fire by means of a damper enables the conductor to keep his car at a practically constant temperature, no matter what the external conditions may be. The use of coal for heating cars is, of course, very economical, and by furnishing a method whereby the dirt and dust is kept away from the floor of the car, has placed at the disposal of the railway managers a most efficient means of adding to the comfort of their passengers.

Nut Locks for Car Work

The Jones Positive Nut Lock Company, of Chicago, is making a specialty of nut locks suited to use on cars where nuts are tightened



NOVEL NUT

against woodwork. The steam railroads have taken up with the nut lock, and are using it extensively. It also makes nut locks for trucks and on iron. The latter consist of a plate, which is prevented from turning by having one edge bent over some part of the truck frame, and having another edge bent up against the nut to lock it after being tightened. The spur locks for use in wood are shown in the accompanying illustration. The lock has spurs which penetrate the wood, and after the bolt is tightened clips are bent up to hold the nut from turning. The spurs are of such shape that the wood cannot shrink away from the lock.

Discussion on Fly-Wheels

The discussion on the paper on the design and construction of fly-wheels for electric lighting and traction purposes, read by A. Marshall Downie before the Institution of Engineers and Ship Builders, of Scotland, and published in the last issue of this paper, has just been published in the transactions of that society, and brought out a number of interesting particulars. Prof. Andrew Jamieson referred to one type of fly-wheel, the description of which had been omitted by Mr. Downie, and that was one in which steel wires of great tensile strength were wound around the periphery of the wheel. Professor Barr also referred to this type of fly-wheel, one of which, he said, was in use at the Mannessman tool works. The fly-wheel was 20 ft. in diameter, and some 70 tons of steel wire were wound on the rim, with a tension of about 50 lbs. The wheel ran at a speed of 240 r. p. m., and had a peripheral speed of about 250 ft. per second, as against, say, 100 ft. per second, which is usually taken as the safe maximum for ordinary cast-iron wheels. A number of the members spoke about the fine coefficient of speed variation referred to by Mr. Downie, and thought that it would be difficult to measure a speed variation of 1-650, as mentioned in the case of one of the engines. Mr. Matthey believed that with a tensile strength of iron of 16,000 lbs. and a factor of safety of 8, a speed of 140 ft. per second could be adopted for rims cast in one piece.

Annual Banquet of the New England Street Railway Club

The second annual meeting, reception and banquet of the New England Street Railway Club was held on Thursday evening, Jan. 23, at the Hotel Brunswick, Boston. This was one of the most successful gatherings ever held in connection with the street railway interests of the country, bringing out over 250 representative men in all branches of the New England railways. The club has had a phenomenal growth, the secretary's report showing at present a membership of 326 operating and supply men, and the crowd that filled the large dining hall of the Brunswick is sufficient evidence that these are active members. Before passing into the banquet an informal reception was held in the parlors and corridors of the hotel, and those present had an opportunity of meeting the guests of honor, among whom were included many men prominent in street railway circles both in and out of New England. A partial list of those present follows: H. H. Vreeland, president Metropolitan Street Railway of New York City and of the American Street Railway Association; G. Tracy Rogers, president of the Binghamton Railroad Company and of the New York State Street Railway Association; Charles D. Kimball, Governor of Rhode Island; A. D. Claflin, president of the Boston Suburban Electric Street Railway; Gen. W. A. Bancroft, president, and C. S. Sergeant, vice-president of the Boston Elevated Railway Company; Col. N. H. Heft, electrical engineer of the N. Y., N. H. & H. R. R.; H. L. Wilson, auditor of the Boston Elevated Railway Company; George W. Bishop, Massachusetts Railroad Commissioner; E. F. Blodgett, Senator, of Leominster, Mass.; E. C. Foster, general manager of the Boston, Northern & Old Colony Street Railway Company; the Hon. E. P. Shaw, of Boston; R. S. Goff, general superintendent of the Old Colony Street Railway Company; H. D. MacDona, counsel of the Metropolitan Street Railway of New York City; H. M. Putney and B. F. Chadburn, Railroad Commissioners of New Hampshire; John L. Bates, Lieutenant-Governor of Massachusetts; W. D. Lovell, of Exeter, Hampton & Amesbury Street Railway; E. L. Freeman, Rhode Island Railroad Commissioner; Frank Ridlon, of Boston; Major H. C. Evans, of the Lorain Steel Company, New York; E. P. Shaw, Jr., of Brookline, Mass.; D. M. Brady, of the Brady Brass Company, New York; C. Densmore Wyman, of Boston; Jonathan Ross, Railroad Commissioner, of St. Johnsbury, Vt.; Jas. P. Jackson, Railroad Commissioner, of Boston; Washington F. Wilcox, Railroad Commissioner, of Hartford, Conn., and Harold A. Clapp, Australia.

The feature of the evening was a powerful speech made by Mr. Vreeland, the principal speaker. Mr. Vreeland took as his subject the benefit of the club to the railway man, but branched out into the relation of the public to the railway man, and vice versa, in the strongest of the many strong speeches he has made on this important topic. Prefacing his remarks by a few words of personal experience, "to prove that he was qualified," he gave a short sketch of his own success, and what led up to it. During his early struggles he had to fight for every bit of education in railway matters, and no one could better appreciate the value of such organizations as the one he was addressing than himself. Leaving personal reminiscence, Mr. Vreeland then said in regard to railways in general: "Railroads have advanced in every respect in the last decade, save one. There we stand to-day where the railroads stood twenty years ago. Then the railroad was small and the president and board of directors owned most of the stock. Cupidity and avarice made them do many things which they should not have done. The people suspected them. The railroads were considered robbers and bandits, and perhaps with some reason. But these things have changed. The public now owns the railroads. The president and the directors are but paid agents and endeavor to give the best service possible and make a profit. Yet the railroad is still regarded as a robber and a bandit. Jurors will not give a just decision often because of prejudice. At one time they had a law prohibiting consolidation, yet the greatest benefits both to the public and to the shareholders resulted from consolidations. It is so bound by restrictions now that it cannot extend its lines without the consent of half a dozen bodies, various public hearings and an insufferable amount of red tape. It took the Metropolitan company twenty months to get 308 feet of track near the ferries, something which was of incalculable value to the public, and it was advertised all over the country as a steal. The street railways are harassed and persecuted all over the country, and they are afraid to stand together and assert their rights. It is time that their position was understood. They must make a stand. So long as they act in conjunction with the law in an orderly manner there should be no interference. The street railway is of more importance to a community than water or gas. The people are absolutely dependent upon it. Stop the railway system in any place and all business will stop. Let the people stop calling us robbers and bandits, and understand what a benefit we are to them."

In a few remarks made by Railroad Commissioner George W. Bishop, of Massachusetts, some interesting data were included. He said: "I was appointed a member of the board in 1895, at the beginning of the mushroom growth of street railways, and it has been very interesting to watch their development. The mileage of street railways in this commonwealth in 1890 was 600 miles, in 1894 900 miles, and in 1901 2177 miles, an increase of about 1200 miles during the last six years. The railways of Massachusetts carried during the year ending September 30, 1901, 433,526,935 passengers. The revenue received for the same was $21,339,480, which would represent a small mountain of nickels and pennies. The employees upon street railways number 14,749, and there are only 14,598 stockholders, or 151 less stockholders than employees; and yet I suppose the stockholders claim to run the roads. Evidence of the confidence of the people of this State in its street railway securities is shown by the fact that out of the fifty-four millions of capital stock represented, forty-eight millions are reported as being held in Massachusetts, and out of the 14,598 stockholders 12,933 are in the State."

The election of the following officers for the coming year was made: President, Edward C. Spring, superintendent of Newton & Boston and Wellesley & Boston street railways; vice-president, E. E. Potter, general superintendent of Union Street Railway Company, New Bedford; vice-presidents for States, C. A. Bodwell, Sanford & Cape Porpoise Railway Company, Sanford, Me.; H. A. Albin, superintendent Concord Street Railway Company, Concord, N. H., A. J. Crosby, superintendent Springfield Electric Railway Company, Springfield, Vt.; W. D. Wright superintendent of equipment, Union Railroad Company Providence, R. I.; J. S. Thornton, superintendent Peoples Tramway Company, Putnam, Conn.; secretary and treasurer, J. H. Neal, chief of department of accounts, Boston Elevated Railway; executive committee, E. C. Spring, Newtonville; E. E. Potter, New Bedford; H. O. Farrington, master mechanic, Boston & Northern Street Railway, Chelsea; E. J. Rauch, master mechanic, Old Colony Street Railway, Brockton; A. J. Purinton, manager of Springfield & Eastern Railroad, Palmer; W. F. Ellis, civil engineer, Boston; J. F. Stone, manager of Boston office of Electric Storage Battery Company, Boston; finance committee, J. F. Wattles, secretary of Rand-Avery Supply Company, Boston; William Pestell, superintendent of motive power of the Worcester Consolidated Street Railway; Paul Winsor, Boston Elevated. E. E. Potter, the new vice-president, was toastmaster at the banquet.

Annual Meeting of the Toronto Roadmasters' Association

The roadmasters of the Toronto Railway Company have an active and excellent organization for social intercourse and improvement, to which, in spite of the title of the association, all permanently appointed officers of other street railway companies are eligible. This association, which is similar to other street railway clubs, held its annual meeting on Jan. 9, 1902, in Toronto. There was a large attendance and much valuable business was done.

An excellent paper was read by Roadmaster J. H. Wallace on the best method of training and disciplining conductors and motormen. Roadmaster E. Whitaker then read a paper on the McCollom momentum friction brake, and the many good points of this brake were brought out very forcibly. Another important paper was read by Roadmaster D. Kearney on the different kinds of sanders in use on the Toronto cars. Extended discussions on each paper followed.

The auditor of the association then read his report, which showed a balance of $25 cash on hand

The election of officers for the year 1902 then took place, and the following officers were elected: President, E. Whitaker; vice-president, Geo. A. Greene; secretary and treasurer, John F. Argue; executive committee, F. M. Blight, D. Kearney and Louis Wheeler.

After the business was transacted, the members retired to McConky's café, where all sat down to an excellent banquet. Twenty-five members of the association and five invited guests were present, and, after all had done ample justice to the spread, some excellent speeches were delivered.

The association has rented a large room in Janes's block, and have furnished it in excellent style as a meeting room. The company is taking an interest in the organization and made a donation of $50 toward furnishing this room.

Electric Railways in Michigan

Next to Ohio, it is probable that more electric railway construction work is being done in Michigan than in any other State. Aside from the operations of the Everett-Moore syndicate in that State, the Hawks-Angus, Boland, Winters-Law, and other syndicates are promoting lines that will result in the State being gridironed with electric railway lines. The development of the Michigan roads has not been spasmodic, but has extended over a period of some years. At the present time there are in actual operation in Michigan no less than twenty-four interurban railways and seventeen city lines, and franchises have been asked for forty-seven roads. No less than fifteen extensive systems are now in course of construction. A list of the city and the interurban lines now in actual operation follows:

CITY LINES IN OPERATION

Detroit United Railway.
Kalamazoo Street Railway.
Adrian Street Railway.
Ann Arbor Street Railway.
Battle Creek Street Railway.
Bay Cities Consolidated Street Railway.
Escanaba Street Railway.
Grand Rapids Street Railway.
Hancock Street Railway.
Jackson Street Railway.
Lansing City Electric Street Railway.
Menominee City Railway.
Mt. Clemens Street Railway.
Muskegon Street Railway.
Pontiac Street Railway.
Port Huron Street Railway.
Saginaw Street Railway.

INTERURBAN RAILWAYS IN OPERATION

Owosso & Corrunna Electric Company.
Detroit, Lake Orion & Flint Railway.
Rapid Railway System, including Detroit & Lake St. Clair and Detroit, Mt. Clemens & Marine City Railways.
Twin City Electric Company, Bessemer to Ironwood.
Manistee, Filer City & Eastlake Railway.
Toledo, Adrian & Jackson Railway.
Toledo & Monroe Railway.
Detroit & Toledo Shore Line.
Grand Rapids, Holland & Lake Michigan Railway.
Michigan Traction Company, Battle Creek to Kalamazoo.
Saginaw Valley Traction Company.
Jackson & Suburban Traction Company.
Detroit, Ypsilanti, Ann Arbor & Jackson Railway Company.
Escanaba Electric Company.
Marquette & Presque Isle Railway.
Negaunee & Ishpeming Street Railway.
Grand Rapids, Grand Haven & Muskegon Railway.
Houghton County Electric Railway.
Detroit, Plymouth & Northville Railway.
Detroit & Northwestern Railway.
Port Huron & Gratiot Beach Electric Railway.
Wyandotte & Detroit River Electric Railway.
St. Joseph & Benton Harbor Electric Railway.

The Scranton Strike

Both the Scranton Railway Company and the strikers are as determined as ever in the controversy that has excited the city since last October. The cars, as previously stated, have now been in operation for some time, but they are not patronized by the members of the labor organizations of the district. However, many of the merchants and business men who at first did not patronize the cars are now riding, and it is unofficially stated that the company will from this time ignore the men, as they absolutely refuse to come to work only under conditions that are prohibitive to the company. G. M. Clark, president of the Scranton Railway Company, recently addressed to the public an open letter setting forth the position of the company. Mr. Clark, in his opening statement, refers to the many misrepresentations, and continues as follows:

In a statement issued to the public under date of Nov. 30, the vice-president of the company clearly outlined the policy of the management, which we repeat briefly, as follows: That the company must have entire control over the employment and discharge of its men; that faithful and competent men now in the service of the company will not be dismissed, and therefore only such of the strikers can be taken back as places can be found for, and that the company is not engaged in a warfare upon organized labor, and does not deny the right of its men to belong to a labor organization.

During the past month there have been several attempts to bring about a settlement by arbitration and otherwise, none of which have offered any practical solution of the difficulty. The last attempt to effect a settlement has been more nearly successful than any previous attempt, the strikers agreeing to all the terms of the company, providing the company would execute a contract with the Union. As the principal object of a contract is to limit the power of the company to discharge men, thus dividing the control of its business between the company and the Union, we have merely repeated our refusal to execute any contract.

Our experience with the previous contract was far from satisfactory, and we doubt if it was satisfactory to our men. Such contracts are not usual among large employers of labor, even in this valley, where labor is so thoroughly organized. There never has been, and is not now, a contract between the Wilkesbarre Railway system and its men. In none of the large cities of this State do such contracts exist. And yet it is this unusual and unwarranted demand, on the part of the leaders of the strikers, and this demand alone, that is continuing the strike and boycott in force.

We are willing to let the strikers themselves determine the question whether their experience under the previous contract from January to October 1, 1901, was satisfactory to them, and we are willing to leave to the calm judgment of the public whether or not the company is justified in demanding full and complete control of its business, including the employment of men and their discharge for proper cause, and that the company must be the sole judge of what is proper cause.

We are not engaged in a warfare upon organized labor. If properly and wisely managed, we would be more inclined to help it, but our experience of the past year naturally leads us to the conclusion that neither this company nor its employees have thus far been benefited by it.

Improvements at Kansas City

Reference has frequently been made in these columns of the immense amount of new work being done by the Metropolitan Street Railway Company, of Kansas City, Mo., and a review of the work that was done during the past year is interesting. No less than three new lines were completely equipped during the year, work on lines begun in 1900 was completed, and the construction of lines that will be placed in operation this year was begun. In all, about ten miles of new track were laid. Now, the new work done by the company was not entirely confined to the construction of new lines, but important improvements were made in the entire property.

The Thirty-First Street line, running from Main to Indiana; the Indiana line, running from Eighteenth to Thirty-First Street, and the Twenty-Seventh Street line, from Prospect to Cleveland, were the three lines entirely equipped during the year. The company also completed the Westport line from Forty-Fourth Street south to Forty-Seventh. It had been arranged to build the Walnut Street connecting link from Thirteenth to Nineteenth Street, but legal difficulties over the right of way held this important work back. The entire length of track on Eighteenth Street was relaid; the arrival of frost prevented the relaying of the Nineteenth Street track. Light rails in various parts of the city were replaced with heavier rails—Eighteenth, Main and other streets seeing the light rails replaced with heavier ones. At almost every intersection of lines curves were put in to admit of switching from one direct route to some other, an improvement that will enable the company to speedily relieve car shortages which may from time to time arise on one line or the other. At the eastern end of the Independence line the track was doubled from the Pacific bridge in.

General as the improvements were, the company yet has two years' such work before it. In 1904 Kansas City will in all probability, see the last cable make its trip.

A new car house was built at Ninth Street, and an addition was built to the Kaw power house. An important work begun by the company was the construction of its new shops, detail description of which appears in the Street Railway Journal for Dec. 7, 1901. The shops will be included in two large buildings covering 13½ acres of land. The total cost of this work will aggregate $200,000.

Probably the most important work planned for this year is the erection of an immense new power house.

ENGINEERING SOCIETIES

The Civil Engineers' Society, St. Paul, Minn., held its annual meeting at Windsor Hotel on Monday evening, Jan 13. President Powell was in the chair, and a number of interesting papers were presented. The following officers were elected for the ensuing year: A. W. Münster, president; A. R. Starkey, vice-president; G. S. Edmondstone, secretary; A. H. Hogeland, treasurer; G. W. Winslow, librarian, and G. L. Wilson, representative to the board of managers of the Association of Engineering Societies.

NEWS OF THE WEEK

The Detroit Three-Cent Fare Case

The United States Supreme Court, so it is reported at Detroit, is nearly equally divided over the city of Detroit's suit to determine whether the Board of Aldermen has the right to compel the street railway company to reduce the fare to three cents, nothwithstanding the terms of the company's franchise. A Detroit contemporary says: "The court may ask for a re-argument of the case. Justice Harlan has been sick for nearly two months, which leaves only eight justices sitting, making an equal division possible. It's over three months since the suit was argued, and it's rare that the court takes so long to announce a decision. The court advanced the case on the docket over several hundred others at the request of counsel, an action which is usually taken to mean that the court consents to hasten final disposition. Only in suits where four members of the court favor an opinion for one side and five for the other are decisions held back as the street railway case has been."

The Everett-Moore Situation

A meeting of the bankers' committee in charge of the affairs of the Everett-Moore syndicate is to be held Thursday, Jan. 30, and it is said that little more can be done of a decisive nature until the reports of the experts concerning the condition of the properties are filed. According to a statement made Jan. 23 the committee now stands ready to receive all bona-fide bids for the purchase of certain of the syndicate properties. But negotiations of such a character can hardly be concluded in the absence of a detailed statement of the condition of the properties in question. It is said that the traction interests are to be disentangled, each one as a business proposition of its own standing. This being done, the situation evolves largely about the telephone interests. Mr. Everett is at present in New York, and it is understood that he has practically been empowered to further negotiations for the sale of the telephone interests. The bankers' committee will, of course, be accurately informed as to the progress made.

Vesselmen Solicitous

Vesselmen on the Great Lakes are viewing with suspicion the rapidly growing practice of utilizing water power for electric transmission purposes. At the recent annual meeting of the Lake Carriers Association the report of the secretary touched on the river and harbor bill now in preparation in Congress. The report said: "It is expected that the new bill will contain a section providing for the appointment of an international commission on the subject of lake levels. The new methods of developing and utilizing water powers, particularly in connection with electric smelting and electric transmission of power to considerable distances, make it certain that at every point where there is a considerable fall of water in the connecting waterways of the great lakes, power will be developed to the fullest extent. This will divert the water from existing channels, and unless the government authorities and vessel interests are on the alert to protect their interests they will find that the interests of navigation are injuriously affected." Why not force people to stop drinking lake water?

More Philadelphia Consolidation Talk

Ever since the passage last summer of valuable elevated and surface railway franchise grants by the City Council of Philadelphia in favor of John M. Mack and his associates, there have been persistent rumors of negotiations for the sale of the franchises to the Union Traction Company. Almost periodically have rumors been renewed, and besides this there have been intermittent statements in regard to the plans for beginning construction work under the franchise grants. Of course, it is more than probable that the publicity given to the franchise question and the operations of the syndicate resulted from ambitions newspaper men, but it would seem that now, for the first time, serious negotiations for the disposal of the franchises have begun. At the request of Mr. Mack, President Parsons, of the Union Traction Company, called a meeting of the directors of that company for Jan. 27, when it was said that a direct proposal for consolidation or purchase was made by Mr. Mack. In the many previous references to the sale of the franchises, the Union Traction Company has always been referred to as the purchaser of the franchises, but it would now appear that the plan of Mr. Mack and his associates is to organize a new company to take over the Union Traction and the franchise rights that he and his associates own. Mr. Mack and his associates were reported to be in New York Jan. 21, and a definite announcement is expected to be issued shortly.

An Athletic Young Woman at the Brooklyn Bridge

An athletic and up-to-date young woman of Brooklyn who is compelled to cross the Brooklyn Bridge at the rush hour has succeeded in solving the problem of always securing a seat. Now it cannot but be said that the "gentlemen" of Brooklyn are very ungallant, for they congregate at the near side of the loops at the Manhattan terminal of the Bridge, and board the surface cars while they are moving. The young women, ladies, old women and men of advanced years have to be content with boarding the cars after they have reached the far side of the loop, and by this time there are few, if any, seats left. Now, it is this that has led this athletic and up-to-date young woman to make her strenuous effort. The car that this young woman takes to reach her home comes in on the first loop—that nearest the street. There are four loops, and this young woman wends her way through the surging mass of humanity until she has reached the fourth loop. Mingling with the ungallant mass of men that is waiting to take the car "on the jump," she slowly, but surely, succeeds in reaching the policemen who hold the mass from encroaching upon the roadway. On these policemen, and they are six-footers, who do not hesitate to punch you in the ribs as a reminder that you are too far on the road, the young woman smiles bewitchingly, and straightway when her car appears takes to the roadway, boards the car while moving and secures a choice seat. The long skirts that it is said would hamper women in a feat of this kind seem to have no terror for this young woman, and it is really pleasing to note the ease and dexterity with which she boards a car. It takes her fully ten minutes, and requires considerable effort to combat the masses until the policemen are reached, but it appears to be worth both the effort and time. Many members of the stern sex undoubtedly wish they could win favor with the police by bestowing a smile upon them, while others no doubt, after having been prodded in the ribs, would dispute the right of the policemen to do this were the law not on their side.

The Hearing on the Application of the New York and Portchester Railway

The hearing on the application of the New York & Portchester Railway before the Board of Commissioners of the State of New York, to construct its line between 132d Street, New York City, and Portchester, and of which full particulars of previous hearings have been published in this paper, were resumed last month when the briefs of the applicants and opponents were filed with the Commissioner. At the hearing the announcement was made by William H. Page, Jr., counsel for the United Railway Company, of New York, that that company desired to withdraw its opposition to the construction of the road. This left the New York, New Haven & Hartford Railroad Company as the only opponent in the proceedings. The points made by the attorneys of this company were mostly of a legal nature, viz., that the company could not construct a rapid transit road in New York City except under the provisions of the rapid transit law, under which it was not admittedly proceeding; that certain technicalities in securing the certificate of incorporation had not been followed out, and that in consequence the filing of that certificate was void; that the applicant company had not fully disclosed all of its plans, and that financially the proposal was not practical.

These points were answered by the applicant company's attorneys, who showed that the territory through which the road passes is now without adequate transportation facilities; that the New Haven Company is incapable of increasing its existing facilities on account of conditions beyond its control; that the construction of the proposed road was entirely feasible, and the estimates of the probable earnings conservative, and that public interests demanded the granting of the certificate. The legal questions brought up by the opponents were all carefully considered and shown to be without force, and the counsel requested the commission to overrule such objections and grant the certificate on the ground of public necessity. The attorneys for the applicant company also submitted two important opinions in defense of their legal position. One of these was by the Hon. Charles Andrews, ex-chief judge of the Court of Appeals of New York State, and the other was by Hon. William Rumsey, ex-justice of the Appellate Division of the First Department of the Supreme Court of New York State. Both of these high authorities reviewed the legal points brought up by the opponents of the proposed company, and stated that none of the objections so made was well taken. The decision of the Railway Commissioners in the case will probably be given early in February.

Electric Railway Construction in Ontario, Canada

If the electric railway projects, for which charters are sought from the Ontario Legislature at its present session, or even a considerable portion of them are built, the province will be gridironed with the roads, as no less than 1046 miles will be added to the electric railway mileage of the province. Twelve companies figure in the applications, the territory in which they are interested extending from Cornwall to Windsor, and if all the projected lines were built there would be a continuous line between those two points, while to the north another system will reach from London to Owen Sound, skirting the shores of Lake Huron. American capital is said to be backing the lines from Toronto to London and Guelph to Waterloo. Many of the new railways will tap a large amount of new territory which at present has poor market communication. The Ontario government is at present giving some attention to the consideration of the rates charged passengers on electric railways, and it is expected that some new legislation will be the result, which would affect the electric railway companies being incorporated. The Ontario Electric Company is asking to build from Toronto to Cornwall, 226 miles, and to Ottawa from Brockville, 55 miles. The Hamilton Suburban Railway is to run to Waterloo; from Galt to Guelph, and from Hamilton to Guelph, a distance in all of 76 miles. The St. Thomas Street Railway Company wants to build from Guelph to Port Stanley and to Aylmer and to London, altogether 33 miles. The London Railway Company desires to secure a charter for 114 miles, being from London to Glencoe, Delaware to Strathroy, London to Ingersoll, Thamesford to Brantford, and Brantford to Hamilton. The Sandwich, Windsor & Amherstburg Railway wants to run 16 miles to Harrow and Tecumseh. The Morrisburg Electric Railway wants to run to Winchester, and to have a branch to Morewood, 29 miles in all. The Petrolia Rapid Railway Company has a scheme for seven radiating lines, running 68 miles, while the Goderich Radial lines, along the shores of Lake Huron, are to be 270 miles in length. The Hamilton Radial Company seeks power to run from Mimico to Toronto, and from Hamilton to Port Dover, 40 miles, and the Toronto & Hamilton Electric Railway proposes to cover the 40 miles between Toronto and Hamilton.

PERSONAL MENTION

MR. R. J. WILSON, of the Bay of Quinte Railway, has resigned from that company to accept the position of superintendent of the Oshawa Electric Railway Company, of Oshawa, Ont.

MR. WILLIAM STEFFEN, division superintendent of the Cleveland Electric Railway Company, of Cleveland, Ohio, died a few days ago. Mr. Steffen entered the employ of the company in 1866 and served for thirty-six years under Superintendent Edwin Duty, who died recently.

MR. J. RODERICK ROBERTSON, of Nelson, B. C., who was killed as a result of the explosion in the Rapid Transit Tunnel in New York on Jan. 27, was the representative in British Columbia of the British Electric Traction Company. Mr. W. R. Brixey, of the Kerite Company, of New York, was seriously injured in the same explosion.

MR. N. A. CHRISTENSEN, of the Christensen Engineering Company, of Milwaukee, is the subject of an interesting biographical sketch published in the Christmas number of the *Successful Americans*. The article gives a sketch of Mr. Christensen's remarkably successful engineering career, commencing with the Royal Danish Navy as naval engineer and including his work in this country. The article is accompanied by an excellent likeness of Mr. Christensen.

MR. HENRY LOCKWOOD PRATHER, well known in electric railway circles in the Central West, died at his home in Cleveland, Jan. 18. Mr. Prather gained prominence through his work in electrically welding rail-joints. He spent two years on Cleveland lines in this work, and then filled contracts in a number of other cities. During the past year he has had a line of general equipment and supplies, making a specialty of copper contact bonds of his own manufacture.

MR. B. H. WARREN'S retirement from the second vice-presidency of the Westinghouse Electric & Manufacturing Company has brought about the following changes in the organization of that concern: Mr. Frank H. Taylor, until recently fourth vice-president, has been advanced to the position of second vice-president, and as such will be in charge of the sales of the company, and have a general supervision over its affairs. Mr. L. A. Osborne, manager of works, has been made fourth vice-president, in which capacity he will have charge of the engineering and producing operations of the company. Mr. Arthur Hartwell has been advanced to the position of sales manager, in charge of the sales organization. Mr. Hartwell has, until recently, occupied the position of manager of the Chicago office of the company. Mr. Philip A. Lange, until recently general superintendent, has been made manager of works, in which position he will have charge of the manufacturing department of the company. The organization in other respects remains as heretofore. Mr. George Westinghouse, president; Mr. Ph. Ferd. Kobbe, third vice-president and treasurer, in charge of financial department; Messrs. G. W. Hebard and W. M. McFarland, acting vice-presidents; Mr. T. W. Siemon, assistant treasurer; Mr. A. M. Mattice, chief engineer; Mr. Charles F. Scott, chief electrician; Mr. B. G. Lamme, assistant chief engineer; Mr. James C. Bennett, auditor.

CONSTRUCTION NOTES

ANNISTON, ALA.—The Anniston Electric & Gas Company will purchase very shortly about 1 mile of 50-lb. standard T-rail, to reconstruct a portion of its track, which is at present laid with light T-rail. They will also purchase a complete car equipment, including trucks, motors and car body.

SANTA BARBARA, CAL.—The Santa Barbara Consolidated Street Railway Company is about to commence work in the construction of a repair shop and car house near the new power station. A large amount of new and repair work will be done in connection with the improvements to be made on the various lines.

REDDING, CAL.—The supervisors of Shasta County recently passed the necessary resolution to permit Boardman Brothers & Company, of San Francisco, to construct electric railway lines—provided, of course, they are the highest bidders for the franchise. The firm desires a franchise to construct an electric road from Redding South to Red Bluff, distant 36 miles, and from Redding west to Weaverville, distant 52 miles. Just west of Middle Creek station on the latter road there will be a branch to Keswick. Under the franchise work is to be commenced within four months and completed within three years.

LOS ANGELES, CAL.—The Los Angeles Traction Company has closed contracts with the Wagner-Bullock Electric Company, of California, for generating apparatus, aggregating 800 kw, for the operation of its street railway lines in and around Los Angeles, Cal.

WASHINGTON, D. C.—Proposals have ben issued by the Washington & Annapolis Electric Railway Company inviting bids for grading the roadbed of the line from Chesapeake Junction to Westport, a distance of 31 miles. The former point is on the eastern boundary of the district where a junction is to be made with tbe lines of Washington Traction Company. Westport is near Baltimore, at the terminus of the lines of the United Railways & Electric Company's lines. It is expected that the contract will be awarded some time in February, and the work of construction begun at once.

ROME, GA.—The City Electric Railway Company, in addition to its proposed 3-mile extension, will shortly commence the reconstruction of 5 miles of track, which is at present laid with 30-lb. T-rail. The company will purchase at once the necessary 50-lb. standard T-rail, with joints complete. The company will also purchase some special track work, in the way of turnouts, switches and crossings.

MACON, GA.—The City Council has passed an ordinance granting to the North & South Macon Street Car Company franchise for the construction of electric railway lines over the principal streets of the city. The franchise granted carries with it a provision that the entire lines of the new company must be completed and in operation within twelve months from date of contract. Senator A. O. Bacon and W. B. Sparks are among those interested in the company.

CHICAGO, ILL.—The Southern Railway Company, capitalized at $100,000, has been incorporated to build an electric railway through Cook County from Lake Calumet to Chicago. The officers and first board of directors are: O. S. Baylies, Joseph Wright, Jacob N. Hopkins, Frederick N. Baylies and Charles T. Allen, of Chicago.

LA SALLE, ILL.—Right of way is now being secured between La Salle and Ottawa for the Illinois Valley Traction Company's proposed new line. The new road will extend between Ottawa and Princeton, and the rails have been ordered for early delivery, the plan being to begin work at an early date. Among those interested in the new road are: W. B. McKinley, of Champaign, Ill.; George F. Duncan and Edward Woodman, of Portland, Maine.

DEKALB, ILL.—The DeKalb, Sycamore & Northern Traction Company, with principal office in Chicago, and with a capital stock of $1,500,000, has been incorporated. The purpose of the company is to construct an electric railway from DeKalb to Sycamore. The incorporators and first board of directors of the company are: O. S. Baylies, Joseph Wright, Jacob H. Hopkins, Frederick N. Baylies and Charles T. Allen, of Chicago.

EAST ST. LOUIS, ILL.—The St. Louis & Belleville Traction Company, which operates the electric lines between East St. Louis and Belleville, has let the contract for a new power house, at the foot of the Pittsburgh Bluffs, to Christ Kuebelkamp for $40,000. The total cost of the improvement, with machinery, will be $150,000.

NOBLESVILLE, IND.—The Central Traction Company has awarded the contract for 150,000 ties for the Indianapolis division of the road. The company has also awarded the Carnegie Steel Company the contract for the rails. Both contracts call for immediate delivery. Several companies are figuring on the contract for the power house, which is to be erected here.

MUNCIE, IND.—The Muncie, Hartford City & Ft. Wayne Railroad Company is now preparing the route of its line for actual construction. It is expected to begin real operations in the early spring, and the promoters are confident of having the line in operation between Muncie and Hartford by Aug. 1. The road will be laid with 70-lb. T-rail. The power plant, car house and shops are to be erected at Eaton, and the plans for these buildings have been drawn. E. P. Roberts & Company, of Cleveland, Ohio, are the engineers for the road.

DAVENPORT, IOWA.—The Davenport Suburban Railway Company has applied to the City Council for a franchise for the construction of an electric railway here. The plan of the company is to build an interurban electric railway to connect Davenport and Muscatine, passing through Buffalo. Local and Muscatine capitalists are interested in the company, which is capitalized at $500,000. Charles G. Hipwell, August E. Steffen, W. P. Halligan, B. F. Aufderheide, A. D. McGugin, H. M. Clark and Richard Schricker are directors of the company.

NEW ORLEANS, LA.—The New Orleans & Carrollton Railroad, Light & Power Company will shortly be in the market for about 7000 feet of track, 9-in. girder rail, with standard joints and tie-rods, to reconstruct its tracks on Barronne Street. The rail is to be laid in asphalt paving, and a rail suitable to these conditions will be required. Considerable special work will also be required to complete the installation.

NEW ORLEANS, LA.—The New Orleans City Railroad is preparing plans for seventeen steam railroad crossings, which are to replace crossings at present in service, and bids will be solicited at a very early date. The most substantial and approved design of crossing will be purchased.

NEW ORLEANS, LA.—The Orleans Railroad Company has in view the reconstruction of all its most important lines, and will be ready to receive bids very shortly for the first installment of rail, amounting to 500 tons, to be used in this work. During the year they will require, in all, 1500 tons more rail to complete their improvements, which will be ordered as fast as needed. The rail to be used will be of the 9-in. side-bearing type, with necessary joints, and other appendages. A large quantity of special work will also be required.

NEW ORLEANS, LA.—John Blair MacAfee, of Philadelphia, has the contract to build the New Orleans & Ponchartrain Railroad. The first installment of track work ordered will consist of about 15,000 feet of track of 7-in. side-bearing rail with the necessary 7-in. special work. Later there will be required a large quantity of standard A. S. C. E. T-rail and special work of the same type. Mr. MacAfee was recently in New Orleans for the purpose of consummating his plans, and as soon as this has been done he will be ready to receive bids.

PITTSFIELD, MASS.—The Pittsfield Street Railway Company has accepted the franchise giving the company permission to extend its lines through Dalton.

WARE, MASS.—The Hampshire & Worcester Street Railway Company is making arrangements to begin preliminary work for its proposed electric railway between Ware and West Brookfield. It is expected that the actual work will be begun, as the ground is in condition to be worked.

PITTSFIELD, MASS.—The Western Massachusetts Street Railway Company has been organized, with a capital stock of $300,000, to build an electric railway from the western terminus of the lines of the Woronoco Street Railway Company in Westfield to Russell, Chester, Huntington, Becket and Lee, a distance of 40 miles. Among those interested in the company are: R. D. Gillett, Joseph D. Cadle and Henry W. Ely, of Springfield; Arthur W. Eaton, of Pittsfield; Franklin Weston, of Dalton; R. D. Rising, of Springfield.

BOSTON, MASS.—It is reported that the Boston Elevated Railway has in contemplation the erection of a seven-story building on a triangular piece of ground owned by it at Tremont Street, Shawmut Avenue and Pleasant Street. The tract contains 13,826 sq. ft. of land, and was acquired for subway purposes.

DETROIT, MICH.—The Detroit, Ypsilanti, Ann Arbor & Jackson Railway Company has its line completed between Ann Arbor and Jackson, and has begun regular service between those points.

LANSING, MICH.—The Common Council has extended the franchise of the Lansing, St. Johns & St. Louis Railway so as to give the company additional time for the completion of its line.

ST. LOUIS, MO.—An opinion rendered by the acting city counselor to the Board of Public Improvements as to whether the St. Louis Transit Company is authorized under the Central Traction ordinance to extend lines state that the consolidation remains effective; that no new routes can be built, but that necessary curves and switches for routes already built may be constructed.

ST. LOUIS, MO.—The Bellefontaine car sheds of the St. Louis Transit Company, which were damaged about $60,000 by fire Jan. 11, were visited by fire again last week. The loss was $2,000.

TRENTON, N. J.—The South Jersey Gas, Electric & Traction Company has recently elected new officers. The company is now represented by: A. R. Kuser, president; Richard Stockton, assistant president ; William J. Brodley, vice-president; Charles G. Cook, treasurer. The directors are Anthony R. Kuser, Thomas N. McCarter, William J. Bradley, Uzal H. McCarter, Forrest E. Dryden, John L. Kuser, William J. Thompson, J. J. Burleigh, H. W. Johnson, Charles Watson, Frank Bergen, Thomas C. Barr, Barker Gummere, Frank O. Briggs, H. C. Moore, Richard Stockton, J. H. Blackwell, William L. Elkins, Jr., Stephen Peabody and Robert C. Pruyn. Senator Thomas N. McCarter, of Newark, was chosen general counsel for the company.

BUFFALO, N. Y.—The petition of the Buffalo, Attica & Arcade Railway Company to extend its line from Java to this city has been granted. The line will run through Elma, Wales, Marilla and West Seneca, and will terminate at Clinton Street and the city line. It will open up a large territory of Erie and Wyoming counties.

NEW YORK, N. Y.—The Rapid Transit Subway Company opened bids Jan. 23 for the erection of the main power house of the rapid transit road, at Fifty-ninth Street and Twelfth Avenue.

LYONS, N. Y.—A hearing will be given the Rochester, Syracuse & Eastern Railroad Company by the State Railroad Commission at Syracuse on Feb. 6. The purpose of the company is to construct an electric railway running parallel with the New York Central and the West Shore Railroads between Rochester and Syracuse, passing through villages with a total of 55,000 inhabitants, seven of which have a total of 18,000 inhabitants, and are situated a mile or more away from the steam railroads. In each of the villages between the two cities local franchises have been granted the company for electric roads to run through the villages, connecting the steam roads with the business and residence portions of the villages.

NEW YORK, N. Y.—The Manhattan Railway Company, which proposes to build an extension of line, at present terminating at Third Avenue and 190th Street, has completed negotiations with the St. John's College for a purchase of a tract of land permitting it to build to 198th Street. From the new terminal, to be known as Bronx Park station, at 198th Street, there will also be constructed a footbridge across the Harlem Railway tracks leading to Travers Street, and giving access to the elevated road from the Bedford Park section of the Bronx between the new Jerome reservoir, the Botanical Garden, Mosholu Parkway and Kingsbridge Road.

SYRACUSE, N. Y.—The Syracuse and Suburban Railroad Company recently secured a franchise from the town of Dewitt for a line from Orville to Jamesville, a distance of 3¼ miles. Two bridges will be necessary.

ELIZABETH CITY, N. C.—The City Council will give a hearing Feb. 3 on the franchise application of the Elizabeth City Electric Railway & Traction Company, which was incorporated Dec. 13, 1901, to build an electric railway here and in the suburbs. Pending the action of the board, the company has not yet perfected its organization, that is, officers have not yet been chosen. The capital stock, with which the company will commence business, has already been subscribed. The nominal capital stock of the company is $20,000; the authorized capital stock is $125,000.

OTTAWA, OHIO.—It is reported that the Toledo & Lima Traction Company, which is building a north and south line, and the Defiance, Ottawa, Kenton & Columbus Railway, which is building an east and west line, are figuring on building a joint power house here.

YOUNGSTOWN, OHIO.—The Mahoning Valley Railway Company is preparing plans for the erection of a large power house in Youngstown, and when completed the present station at Edinburg will be used as a transformer station. Plans are also being prepared for a fine passenger and freight station to be erected at the New Castle terminus. The New Castle extension will be placed in operation about Feb. 1.

SPRINGFIELD, OHIO.—Three distinct companies are working to secure right of way for a line from Springfield to Washington, C. H., by way of Jeffersonville and South Charleston. The Dayton, Springfield & Urbana Railway is figuring on building a spur line over this route.

DAYTON, OHIO.—Stockholders of the Ft. Wayne, Dayton & Cincinnati Traction Company have elected the following officers: Dr. S. George, president; D. W. Le Fetra, of New York, vice-president; Charles L. Hyde, Pierre, S. D., second vice-president; Charles W. Gebhart, secretary-treasurer, and Clifford E. Swayne, of Dayton, auditor. The company is to construct an electric railway to connect Cincinnati and Dayton, Ohio, with Ft. Wayne, Ind.

DAYTON, OHIO.—The County Commissioners have granted the Dayton & Northwestern Traction Company an extension of its franchise for six months. Work on the line was to have started Feb. 1.

CANTON, OHIO.—At the annual meeting of the Canton-Akron Railway Company the old officers and directors were re-elected. The property is held under option by the Northern Ohio Traction Company to be turned over when completed. The contractors will probably be unable to complete the road before spring, as an injunction restraining work has been granted against them.

KENTON, OHIO.—The Dayton & Kenton Traction Company has elected officers and directors as follows: E. M. Hopkins, of New York, president; W. W. Steeles, of Detroit, vice-president; H. S. Forgy, of New Carlisle, Ohio, secretary; C. L. Hubbard, of Dayton, treasurer, and B. H. Rannels, of Dayton, general manager. The above, with C. H. Pomeroy, of Saginaw, Mich., and R. S. Wilcox, of Dayton, are directors.

CLEVELAND, OHIO.—Within a few days City Clerk Toland will advertise for proposals for the construction of electric railway lines over the routes defined in the so-called three-cent-fare ordinance passed by the City Council. Bids will be opened Feb. 10. It is generally believed, however, that despite Major Johnson's claims, there will be no proposals, since the requirements are so severe that it would be impossible for roads to pay expenses, to say nothing of making big money.