Street Railway Journal

VOL. XVI. NEW YORK AND CHICAGO, JULY 7, 1900. No. 27.

SOME NOTES ON THE OPERATION OF THE POWER PLANT OF THE CHICAGO & MILWAUKEE ELECTRIC RAILWAY COMPANY

The satisfactory operation, during the past year, of the power generating and distributing system of the Chicago & Milwaukee Electric Railway, makes some of the unusual features which were adopted in this installation of greater interest to other roads which have difficulties calling for similar apparatus that they have been unwilling to install until it has been tried by pioneers. Among the unusual features of the Chicago & Milwaukee equipment at the time when it was laid out, although they have already

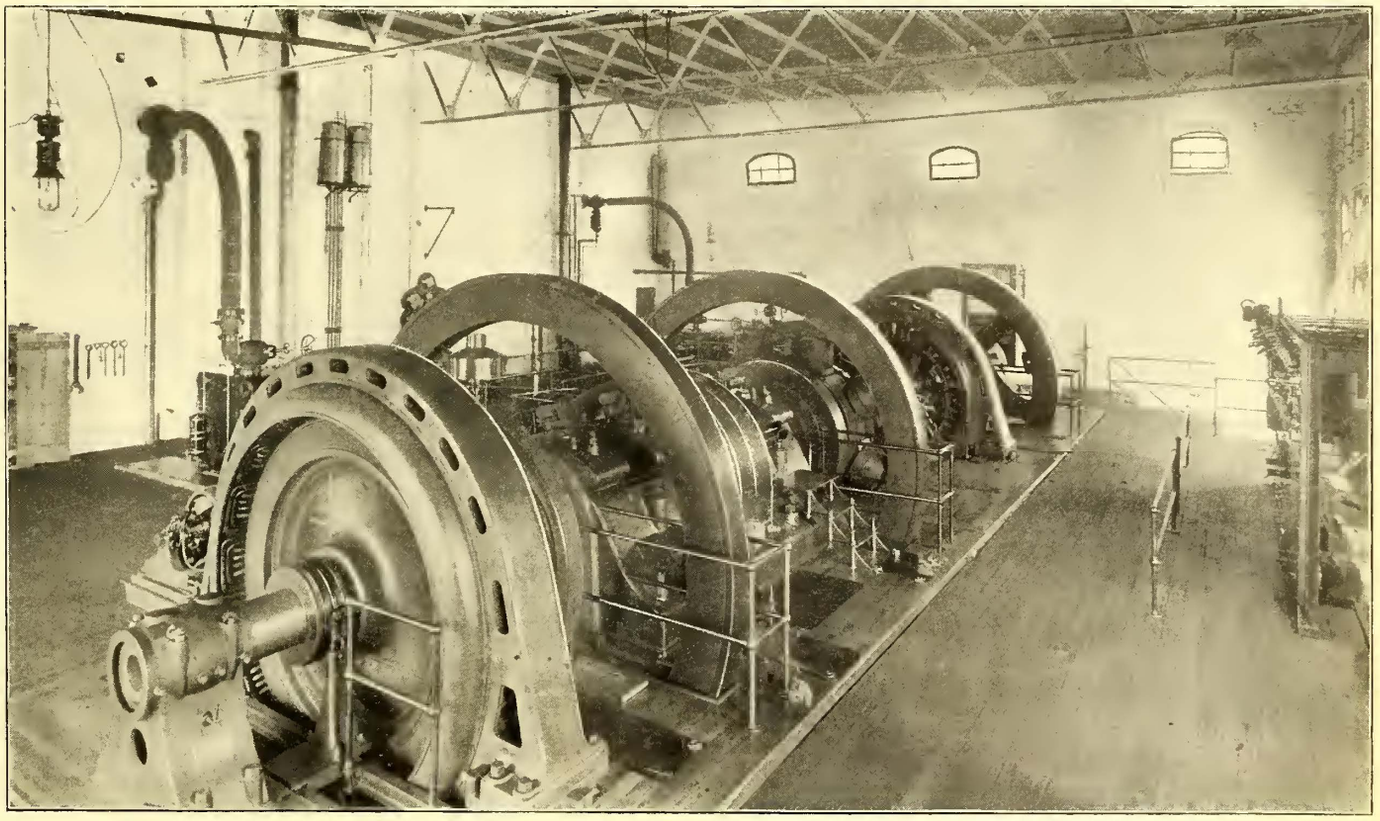


FIG. 1.—INTERIOR OF POWER STATION, CHICAGO AND MILWAUKEE ELECTRIC RAILWAY

come to be more nearly standard practice, are the following: First, a complete polyphase transmission system from the power station to sub-stations with rotary converters and storage batteries; second, the Arnold system of coupling several engines and generators to each other in any desired combination; third, the use of a cooling table for the condensers. The operation of these three features will be explained below in the reverse order to that in which they are here mentioned, the cooling table being taken up first.

There are in the power station at Highwood two Filer & Stowell tandem-compound horizontal engines of two sizes, in order to give at all times a load factor as high as possible with such a small number of engines. The exhaust steam from these engines is handled in two Deane jet condensers and independent air pumps. The station being inland, there is no opportunity for obtaining sufficient cold water for condensing purposes. A cooling pond of sufficient area to handle the exhaust steam output of this station would prove expensive in this location, and cooling towers would require a considerable amount of power for the operation of their blowers, if of the forced-draft type, and would be quite expensive if of the natural-draft type. On this account the consulting engineer, B. J. Arnold, decided to use a cooling table, this being virtually a small cooling pond, the surface of which is multiplied by causing the water to circulate over a number of wooden platforms, slightly inclined so as to cause a flow of the water from end to end of each. The arrangement of these parts is clearly indicated in the view of one end of the cooling table, Fig. 2, and the detail drawings shown in Fig. 3. In this case the number of platforms over which the water has to flow before it falls into the pond is three; the platforms being so inclined that the water flows back and forth over the whole surface of all of them in succession before falling into the pond, from which it is drawn by the condenser suction. The air is allowed to circulate freely between the

platforms, which are exposed so that the wind blows through and constantly carries off from them the water which evaporates. In this way the available surface for evaporation over a pond occupying a given space is greatly increased, making it possible to cool the condensing water of a large plant in a reasonable space without power-consuming auxiliaries or such expensive draft-producing towers as are necessary in a natural draft arrangement.

At the Highwood plant the pond itself is about 150 ft. x 60 ft. in size, banked or excavated to a depth of about 5 ft., a 13-in. brick wall being carried up from the banks to a height of about 2 ft., giving a basin about 7 ft. deep. This is floored by 4 ins. of stone concrete, the walls of the basin having sloping faces of stone concrete with a ⅜-in. cement facing, as is clearly shown in the drawings. The table itself is not as large as the pond, being only 132 ft. in length by 31 ft. in width, the arrangement of its timbers and planking being clearly shown in the drawing. The outcoming hot water from the condensers discharges on a flaring incline, as shown in the photographic illustration, Fig. 2, being distributed the full width of the table by distribution boards, forming a sort of slotted dam. The table, of course, steams constantly when the plant is in operation, as the view indicates, but the steam is not found objectionable in any way either around the property of the railroad company at Highwood or the neighboring residence district, and is dissipated in the coldest weather without the formation of any ice on neighboring objects as might be anticipated. With the usual load on the plant, which drives twenty motor cars, most of them long heavy interurban cars, and eighteen trailers, a vacuum of about 22 ins. is obtained in the summer, this running up to 24 or 26 ins. in the winter season. In ordinary weather the condenser discharge has a temperature of 115 or 120 degs., the water being returned at about 90 degs. F. The cylinder oil from the engines collects, as the illustration shows, in the corners of the pond, and can be drawn off and partially recovered, if desired. The evaporation from the pond is, of course, supplied by the addition of fresh feed water obtained from the town water supply, this feed water finding its way to the cooling pond through the jet condensers.

As noted above, the engines and generators are all set up with their shafts in one line and are provided with magnetic clutches for driving any desired one or more of the generators from either or both engines; this being probably the first railway plant in this country completely equipped with this system and its magnetic clutches, by means of which machines may be coupled or uncoupled while the apparatus is in motion. The general arrangement of the engines and generators is shown in the power house plan, Fig. 4. There are three generators, one a 250-kw direct-current machine designed to supply that part of the line which can be reached economically with direct current from the power house. The other two machines are 25-cycle three-phase alternators, each rated at the same power as the direct-current machine, or 250 kw. As will

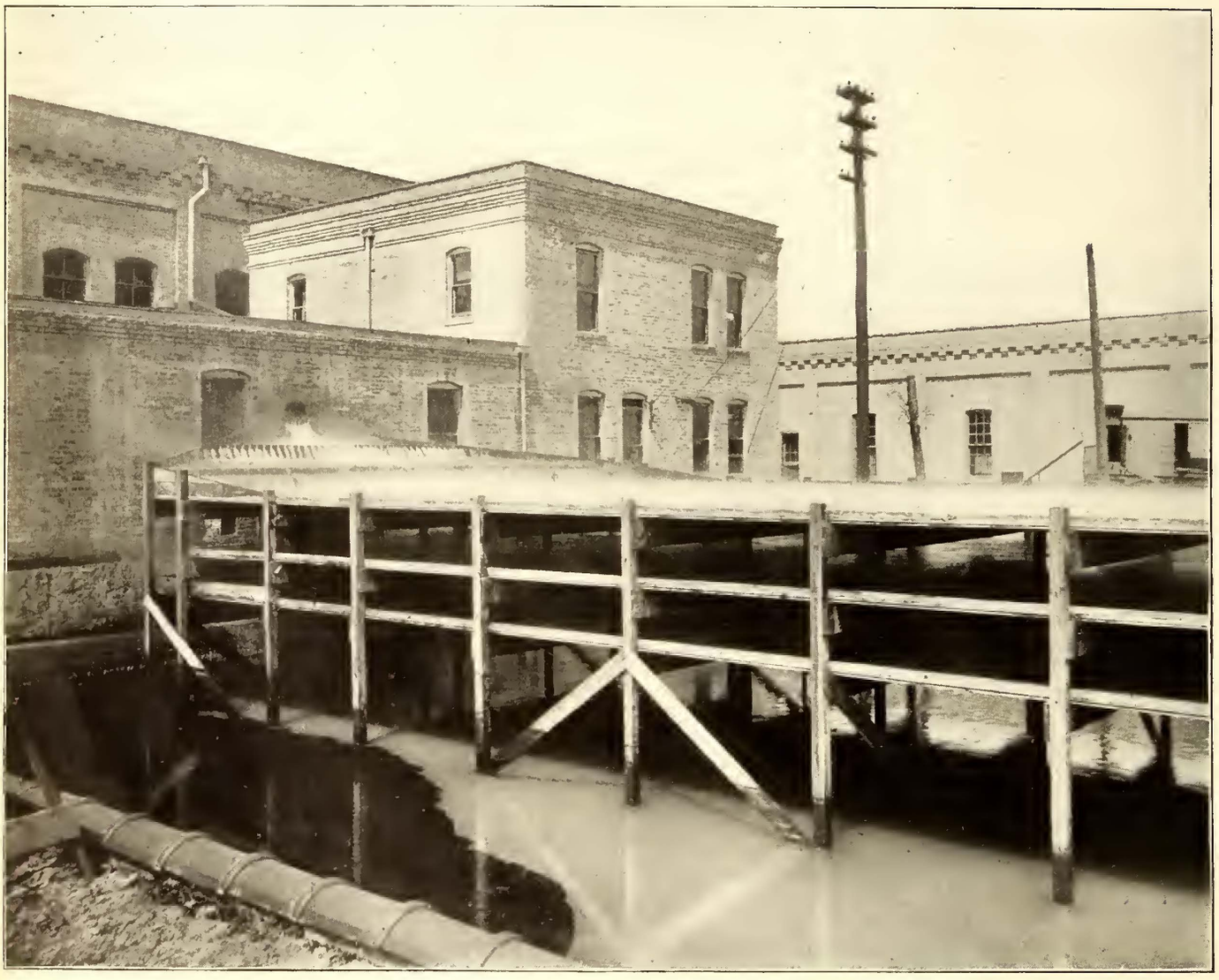


FIG. 2.—COOLING TABLE AND POND

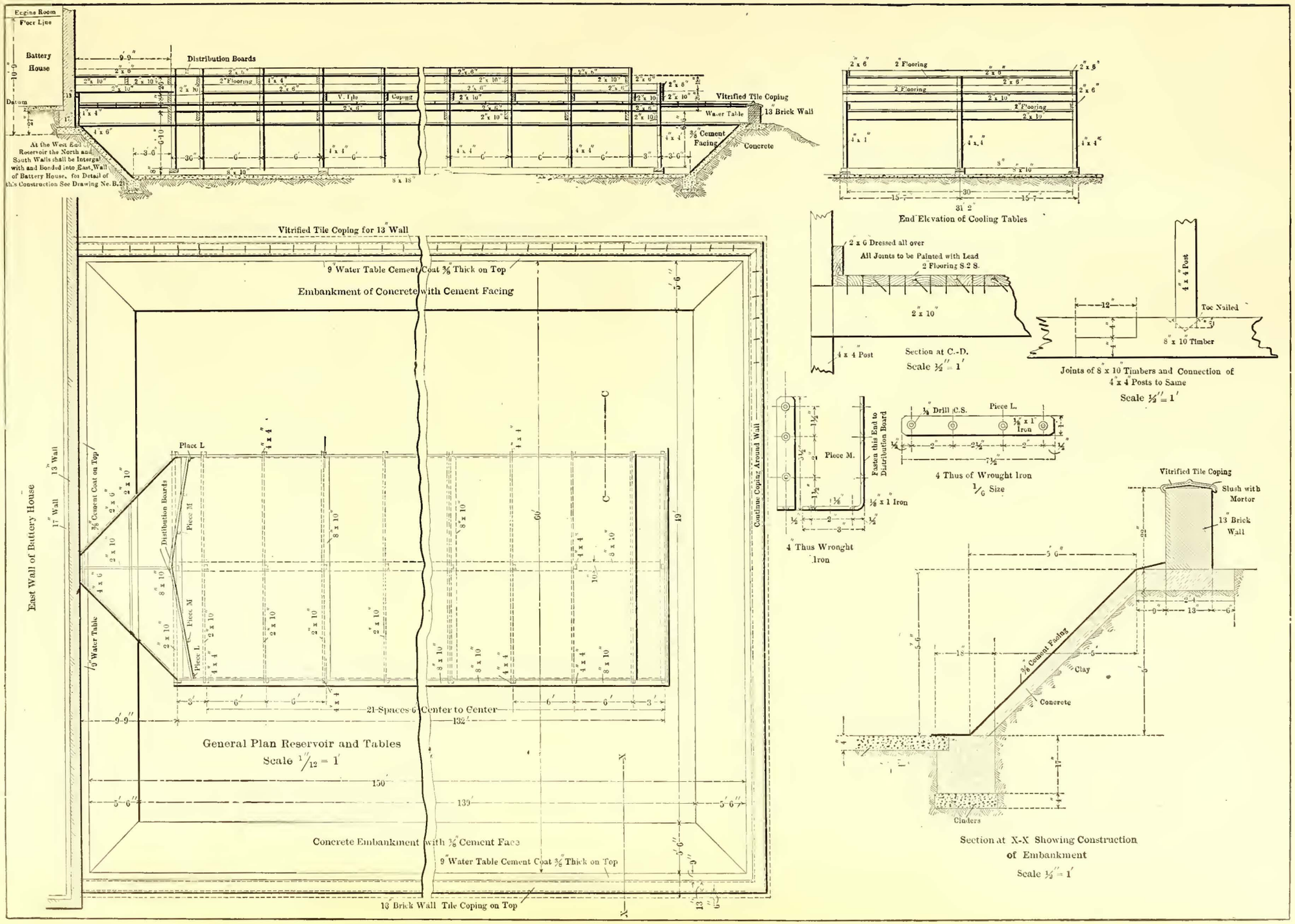


FIG. 3.—SECTIONS, PLAN AND DETAILS OF COOLING TABLE AND POND

be seen by the plan, and by the general view, Fig. 1, one of the alternators is mounted outside the larger engine, the other alternator and the direct-current machine being mounted between the larger engine, which is of the center-crank type, and the smaller engine, which is of the side-crank type and is located at one end of the line. The alternator located outside of the large engine can be driven from that engine alone, but either or both of the machines between the two engines can be driven from either or both of the engines, working either independently or coupled together. The arrangement of the shafts and couplings for accomplishing this purpose is shown more clearly in the section of that part of the shafting between the two engines, reproduced in Fig. 6. In this drawing it will be seen that the rotating parts of the two generators are mounted, not on the solid shaft itself, but on hollow shafts

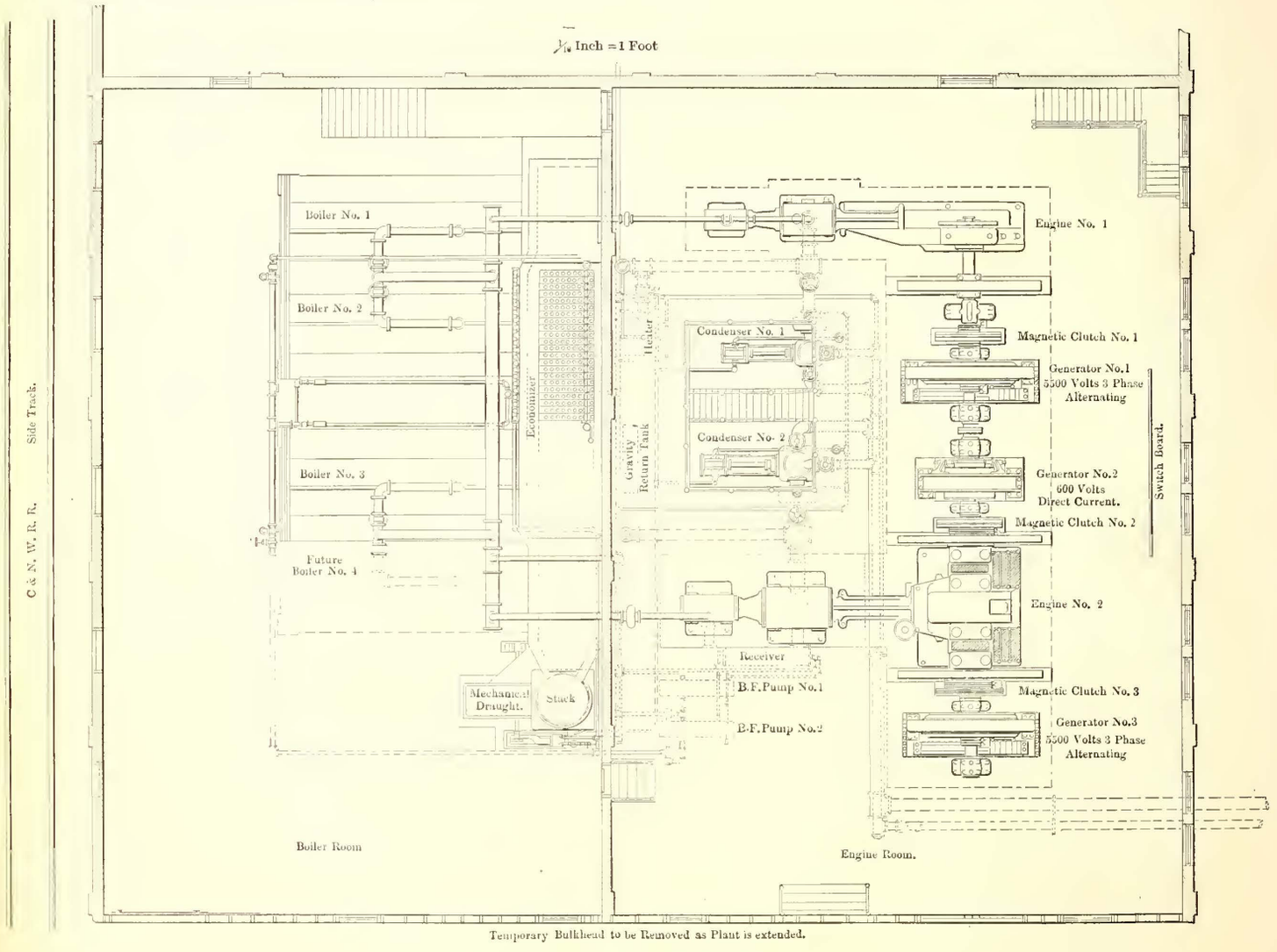


FIG. 4.—PLAN OF POWER STATION

or quills surrounding the solid shaft. Each of these quills —one carrying the armature of the direct-current machine and the other the rotating field of the alternating-current machine—is supported in two quill bearings and carries on one end a disc of what is termed a "three-way magnetic clutch." Each of these three-way magnetic clutches has three sets of spokes and three rims; the central one is attached to the inner solid shaft, one of the outer rims is attached to the adjacent quill and the other to the adjacent engine shaft. Coils embedded in the rims and concentric with the shaft are arranged to draw the central rim toward either of the outer rims and thus clutch the solid shaft to either the quill or the engine shaft. Other coils are provided to draw the two outer rims of one magnetic clutch together and thus join the dynamo quill to the engine shaft. By energizing two coils in one magnetic clutch the solid shaft, the quill and the engine shaft may be all clutched together if necessary. Thus, for example, by drawing together the two outer rims of the right-hand clutch, as shown in Fig. 6, the direct-current generator is connected to the large engine; by drawing over the central rim of the same clutch and by attaching the central rim of the left-hand clutch to the right-hand rim of the same clutch both generators are connected to the large engine. In a similar way either or both generators can be connected to the small engine, or one generator can be connected to each engine or both engines can be clutched together, driving either or both generators.

It will be noted that the central solid shaft is in two sections, fastened together at the center by an ordinary bolted flanged coupling, for convenience in erecting and repairing. This solid shaft runs in two shaft bearings immediately adjacent to the central coupling. When its ends are not clutched to the quill or engine shafts the greater part of the solid shaft overhangs its bearing. When its ends are not clutched in the magnetic clutches, however, the solid shaft is not rotating, so that the overhang is no disadvantage.

The alternator at the extreme end of the system and outside of the larger engine is also connected to this engine through a magnetic clutch, but can be driven only by the large engine. It will be noted from the general view, Fig. 1, that this alternator is also mounted on a hollow quill,

so that when extensions are made to the system a solid shaft can be put through this alternator to connect it to the next engine in the line in the same way that the two other generators can now be connected to either engine.

By means of this system the failure of any one dynamo does not incapacitate either engine, nor does trouble with any engine throw out of service any dynamo, while failure of the larger engine only shuts down one alternator. The larger engine is sufficient in size to carry the usual load, and a reserve source of power is provided without using another engine of the same size by fitting the smaller engine with a by-pass in such a way that both its cylinders can be supplied from the boiler and exhausted into the condenser, a reducing valve being used in the connection to the low-pressure cylinder. In this way it will deliver enough power to run one alternator and the direct-current machine to carry the usual load on the power plant. There being only one direct-current generator, this is always kept in operation to feed the adjacent sections of track, although service could be continued in case of failure of this generator by feeding back from the sub-stations and by virtue of the storage battery at the power station. Normally the direct-current machine and one alternator are run by one engine, in case of light load by the small engine, and in case of heavy load by the large engine. At the time the photograph reproduced in Fig. 1 was taken, it will be seen that the large engine was in operation, driving the alternator at the left-hand end of the line and the direct-current machine. At any time the couplings may be changed so that the small engine at the right-hand end of the line may drive the alternator adjacent to it and the direct-current machine. There is no provision for bringing the generators up to speed by electrical means when the engines are running so that the generators can be started and coupled to the engines without stopping the latter, an arrangement which is in some cases provided with the Arnold system in lighting stations. If the load is sufficiently heavy to call for the operation of both the alternators at

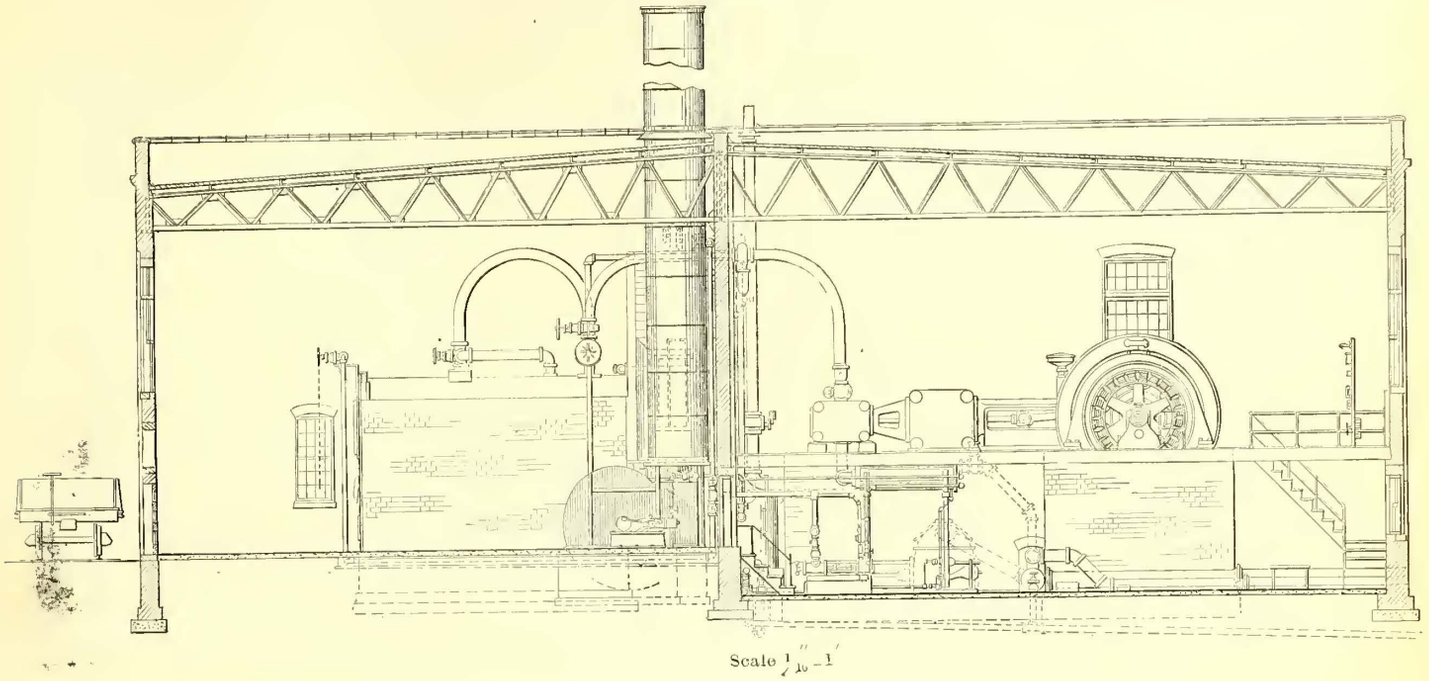


FIG. 5.—SECTION OF POWER STATION

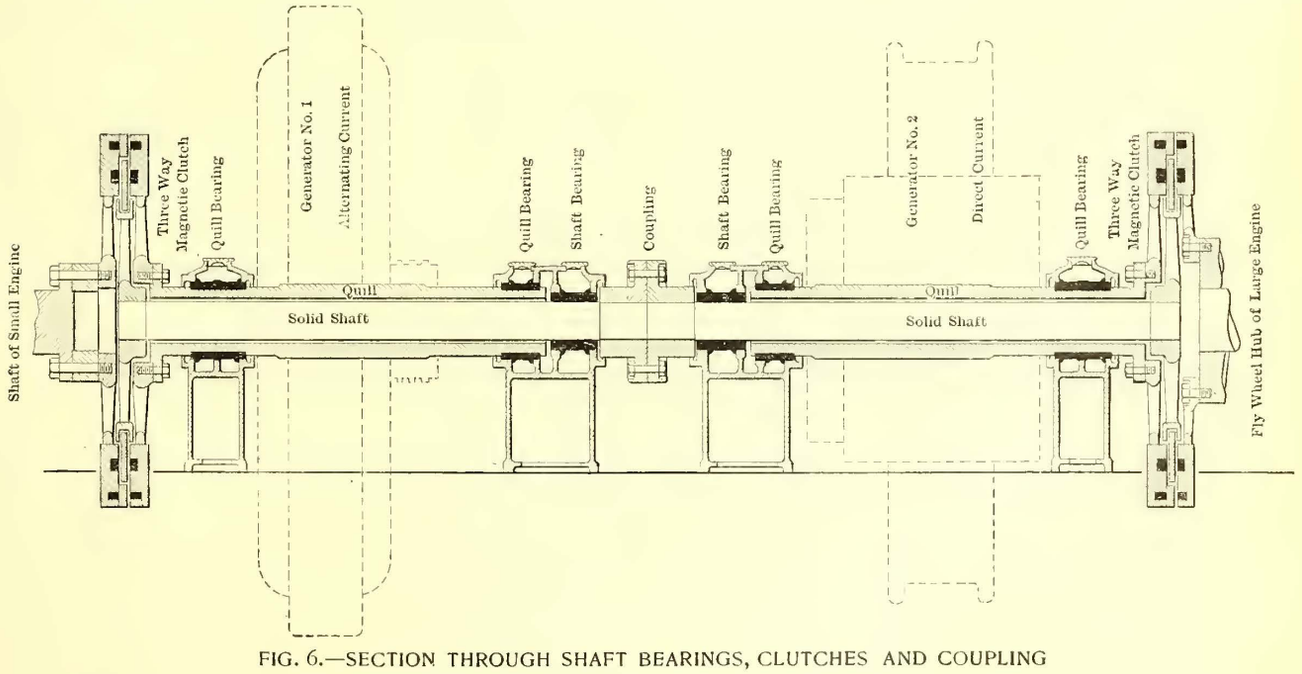


FIG. 6.—SECTION THROUGH SHAFT BEARINGS, CLUTCHES AND COUPLING

the same time they are generally driven from the two engines respectively, one alternator taking the load of one sub-station and the other taking the load of the other sub-station, so that they are not in parallel with each other. They can, however, be synchronized in the usual way and thrown in parallel, after which the clutches may be operated if desirable, so as to couple them mechanically to each other and drive them from the large or both engines. The fields of the alternators are supplied by exciters which are belted on the face of the magnetic clutches, as shown in Fig. 12, the belt covering only a portion of the surface so that it will not interfere with the operation of the parts.

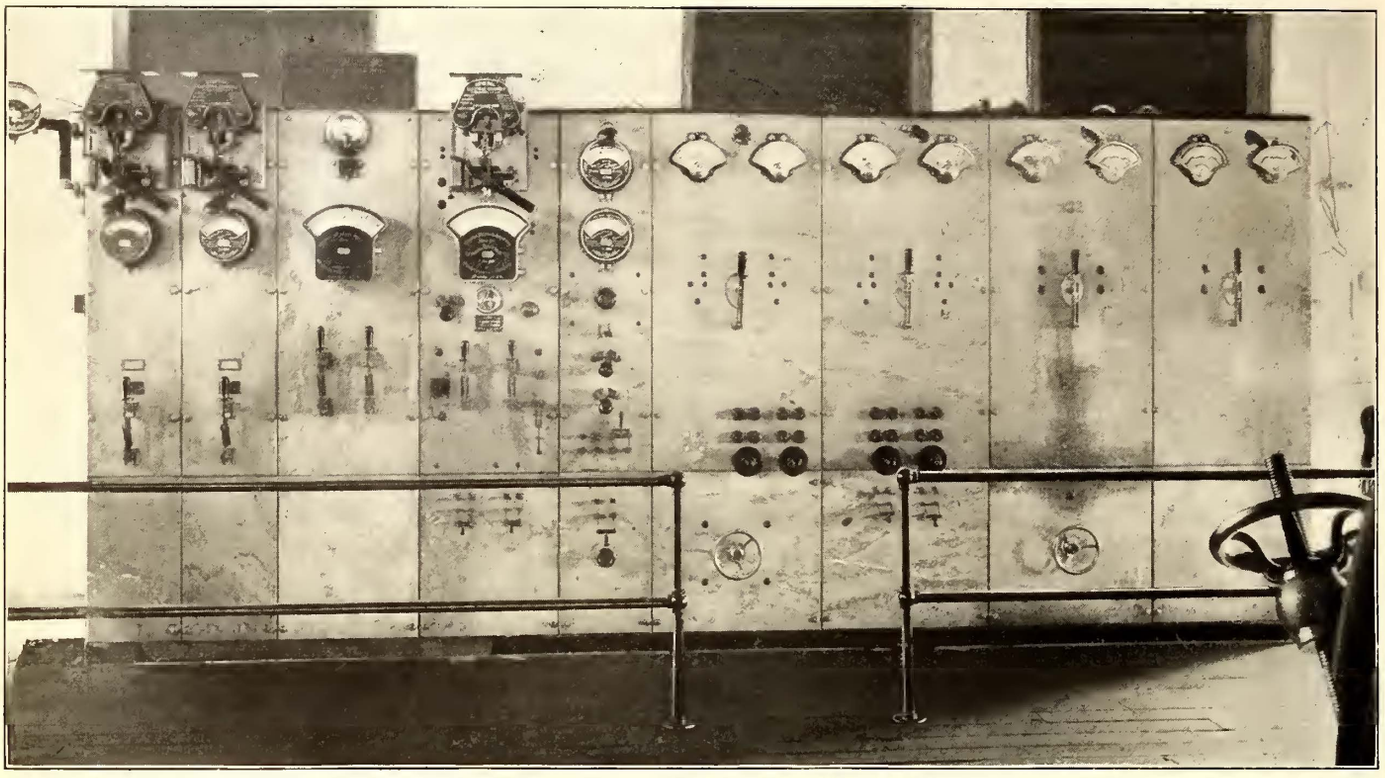


FIG. 8.—SWITCHBOARD AT MAIN STATION

FIG. 7.—CAR ON TRESTLE

THE ELECTRICAL CIRCUITS

The alternators deliver their output at full line pressure of 5500 volts, thus avoiding the necessity of any step-up transformers. There are no fuses in the circuits between the generators and the switchboard, spring-expulsion type fuses being used in the outgoing high-tension lines. The switchboard of the generating station, as shown in Fig. 8, is somewhat unusual on account of the combination of direct and alternating-current machinery. To the left are two ordinary direct-current feeder panels, next to which is a battery panel, and next to that a generator panel; the narrow panel is for the exciters, the remaining four panels being alternator and alternating-current line panels. The only notable feature about this board is the use of high-tension voltmeter receptacles and plugs, by means of which only one transformer per voltmeter is used instead of a transformer in each phase of each line to be measured, as is required when low-tension plugs and receptacles are made use of.

The overhead trolley line, 27

miles in length, is divided by section insulators into three sections, each about 9 miles in length. The middle section is supplied from the direct-current generator at the power station and each of the two end sections is supplied from a rotary-converter and storage-battery sub-station. The three sections are normally tied together electrically on the 600-volt lines so that they help each other. The two sub-stations are almost exactly like each other and each contains two 125-kw General Electric rotaries, a view of a pair of these machines being shown in Fig. 9, from which it will be seen that they are of the type with overhanging collector rings. They were set up with their shafts in line in order that they might be coupled together to allow for the turning of the commutators and to prevent pumping. Although the sub-stations are fitted with storage batteries, this available source of current for starting the rotaries as direct-current motors is not used, the machines being started from the alternating-current end. No reactive coils or compensators are provided, the alternating-current leads of the machines being simply closed, with the fields of the rotaries unexcited, the machines coming up to speed by an internal induction-motor action, this method requiring less skill on the part of the operators than starting from the direct current end. It would be preferable, in a plant of this kind, provided the operatives were sufficiently skilled, to start from the direct-current end, either by means of power transmitted from the generator at 600 volts, the 600-volt wires being normally connected together, or better by means of current from the storage batteries, and it was the intention of the designer of the system to operate them so by batteries ultimately, the only objection being the increased complication.

The rotaries are compound-wound and provided with

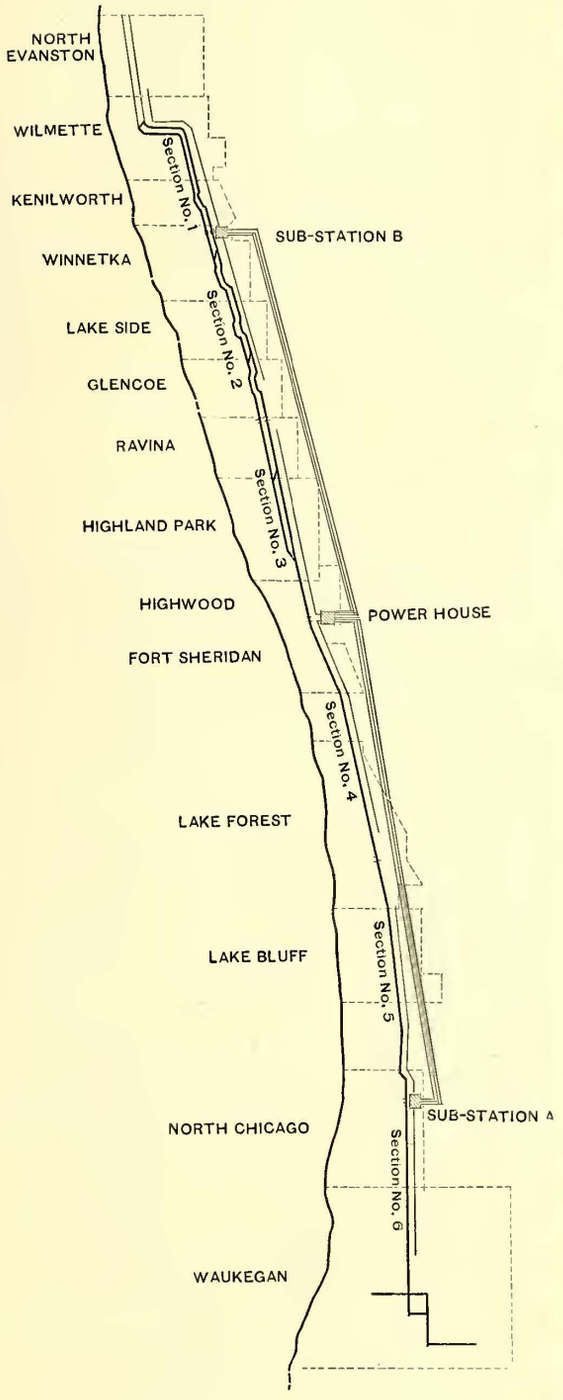


FIG. 11.—MAP SHOWING LOCATION OF FEEDERS

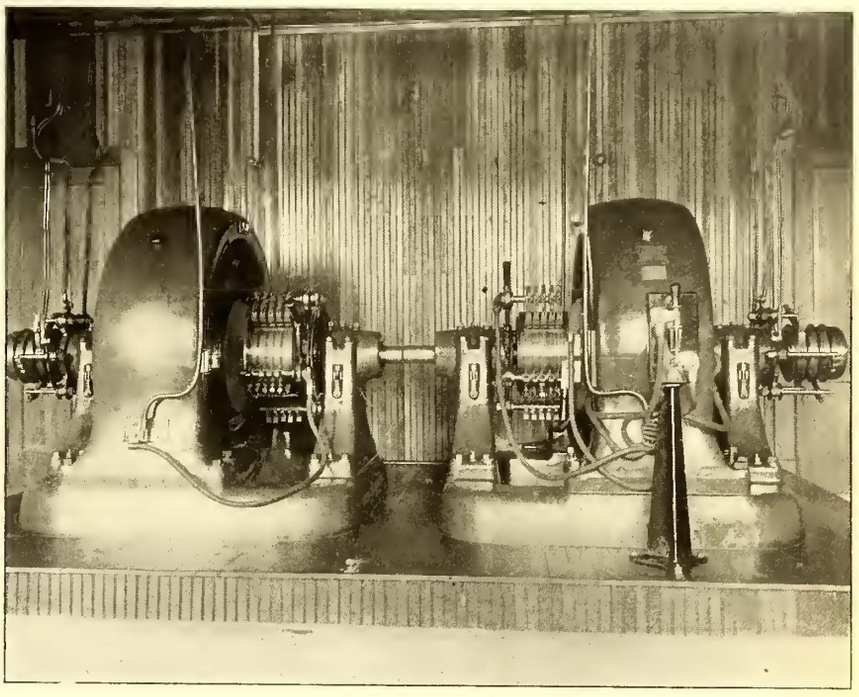


FIG. 9.—ROTARIES AT SUB-STATION

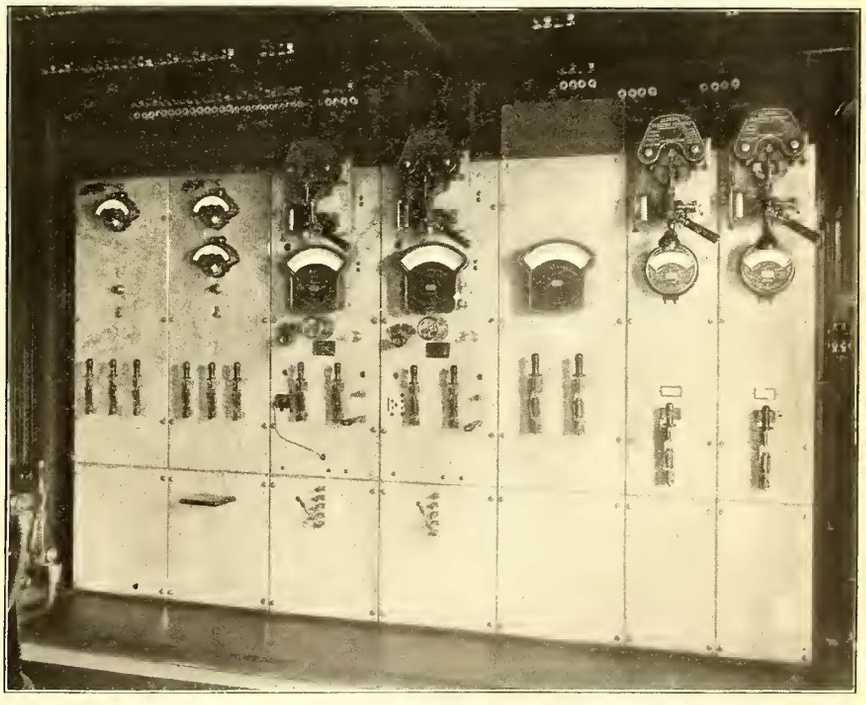


FIG. 10.—SWITCHBOARD AT SUB-STATION

the usual equalizer, the series coils tending to keep up the voltage even without the use of special reactances in the alternating circuits, the reaction of the machine windings of the transformers and of the line being sufficient to give practically constant potential under load variations. There

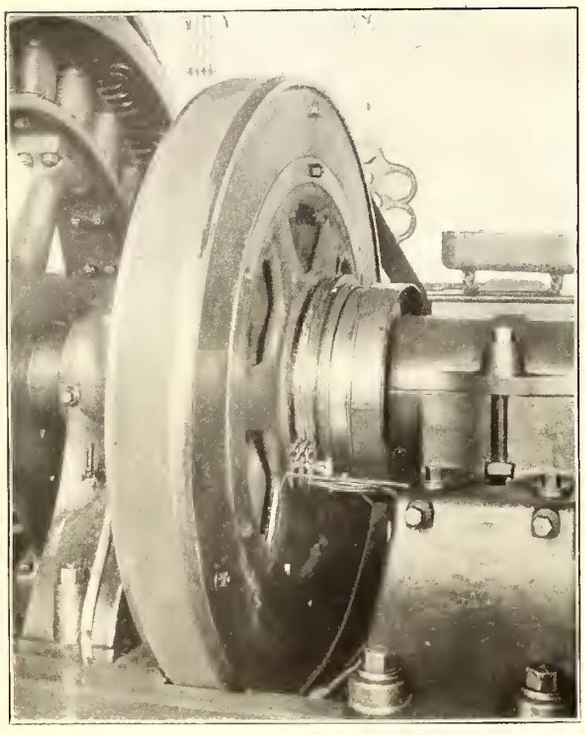


FIG. 12.—ONE OF THE MAGNETIC CLUTCHES, SHOWING COLLECTOR RINGS AND BRUSHES

are no circuit breakers in series with the batteries. No serious trouble is experienced with hunting of the rotary converters, even though the generators are driven by single-crank engines.

As noted above, the road, which runs on private rights of way for about three-fourths of its 27 miles, through many suburban towns scattered along the shore of Lake Michigan from Evanston to Waukegan, is equipped with some twenty motor cars and eighteen open trailers. The large double-truck through cars are equipped with G. E. 57 motors, geared up for a speed of about 30 miles per hour, which can readily be made on the long stretches of well ballasted private rights of way which exist between some of the towns passed through. The fares charged run about 1 cent per mile, varying from 5 to 35 cents, and the traffic developed during the short season the road has been in operation amounts to 7000 or 8000 passengers per day in the winter, and 30,000 to 35,000 in the summer, with more on Sundays and holidays.

The successful operation of this road with its several deviations from standard practice reflects credit on the gen-

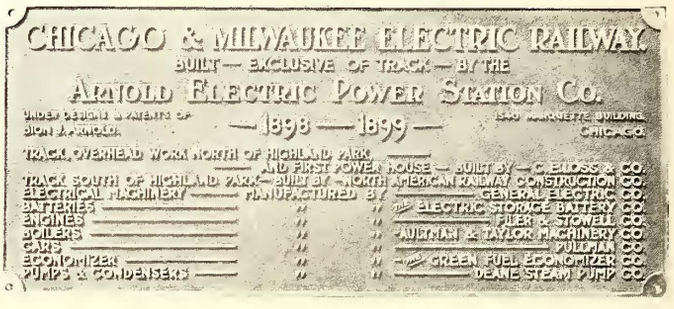


FIG. 13.—NAME PLATE ON SWITCHBOARD

eral superintendent, R. S. Ives, as well as on the various builders of the system and the apparatus used therein, whose names may be noted on the above reproduction of a name plate mounted on the switchboard of the power and sub-stations.

Polyphase Apparatus for Long-Distance Roads in Providence

The Providence & Suburban Railway Company, of Providence, R. I., operates several long-distance extensions in close connection with the city lines of the Union Railroad Company, of Providence. These companies are about to install an extensive three-phase system for supplying power from the Providence station to sub-stations on the extensions. Two 1500-kw three-phase 25-cycle General Electric machines will be erected as generators for this purpose. George B. Francis, formerly in charge of the engineering work on the Southern Terminal Railroad station in Boston, has charge of this work in Providence.

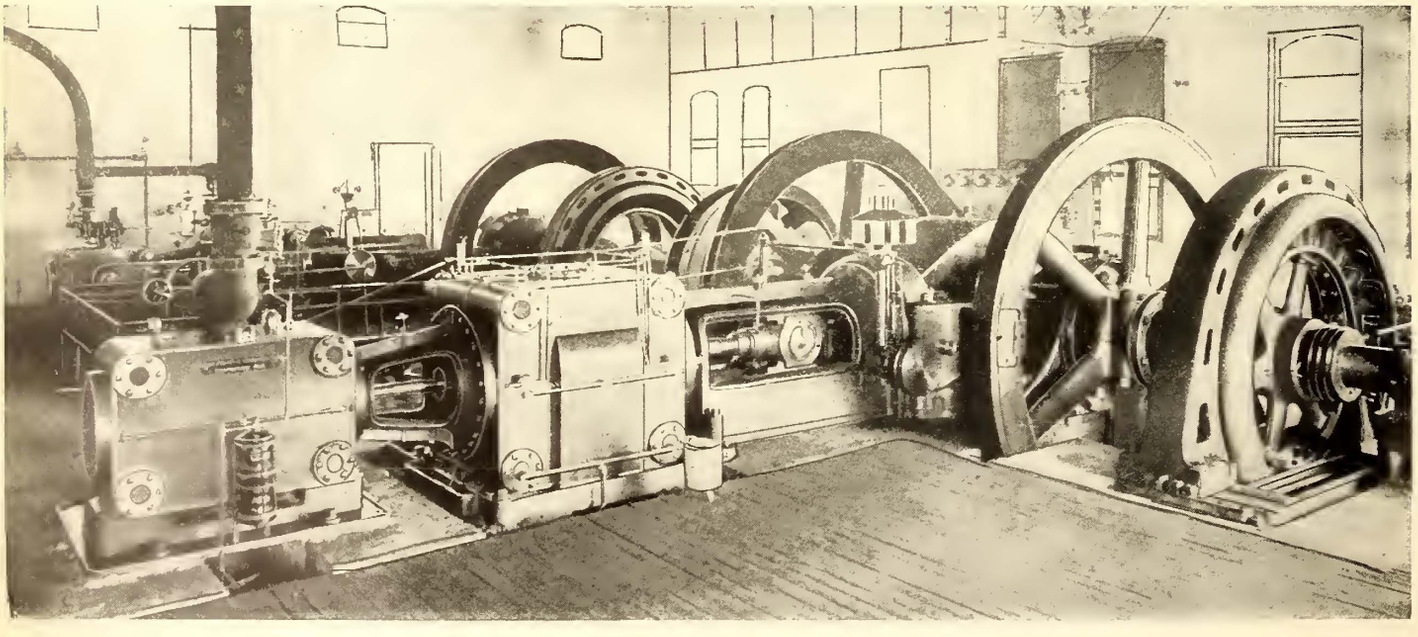
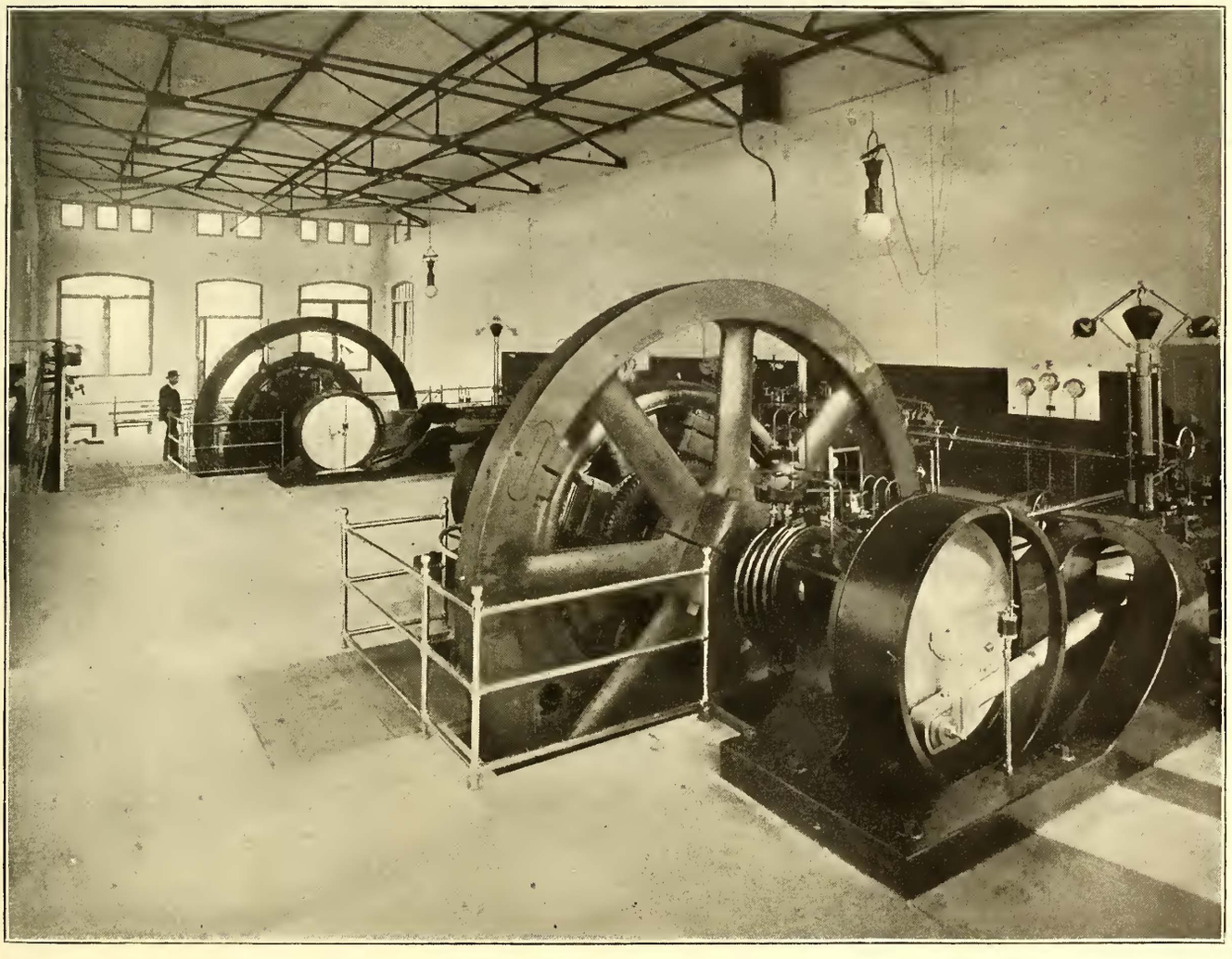


FIG. 14.—VIEW OF ENGINES IN POWER STATION

The Worcester & Webster Electric Railway

The City of Worcester, Mass., the second city in the State in wealth and population, compares very favorably with, if it does not exceed, Boston in the variety and extent of its industrial enterprises and is growing rapidly. For a long time the city displayed unusual conservatism in the introduction of suburban electric railway lines. But being the center of a highly industrial region, this condition could not long remain, and to-day Worcester is abreast of all rivals in local and suburban facilities for rapid transit.

Of the six distinct suburban lines now in operation, which practically annex to Worcester the principal towns and villages within a radius of 20 miles, and with various terminal connections beyond, the Worcester & Suburban Railway Company's lines to Spencer and Millbury were the first to be completed, and the Worcester & Webster Street Railway is the latest. This latter line, which has received much favorable comment for all that relates to thoroughness in construction, high speed and convenience, not to say luxury, of the traveling public, is the subject of this article.



INTERIOR OF ENGINE ROOM, WORCESTER & WEBSTER ELECTRIC RAILWAY

The route runs through one of the most beautiful and picturesque sections of Central Massachusetts, passing southward through the old time settlements of Auburn, North Oxford and Oxford, the latter a typical New England town of homes and churches, with many historical associations, including the remains of the old fort of early Colonial days on Huguenot Hill. Continuing through East Webster, a delightfully rural region, to the busy town of Webster with its population of 12,000, the pleasure seeker by this route arrives within a short distance of one of the largest fresh water lakes in the State, enjoying the euphonious Indian name of "Chaubunagungamaug."

The company was organized with a capital stock of $150,000, rights of the various towns obtained, and $150,000 worth of bonds have been issued. The engineering of the whole enterprise was conducted by E. E. Carpenter, president and manager of the New England Electric Railway Construction Company, of Worcester, Mass. The work of construction was begun in the spring of 1899 and the cars were in operation in the following September, in spite of many obstacles of grade and alignment.

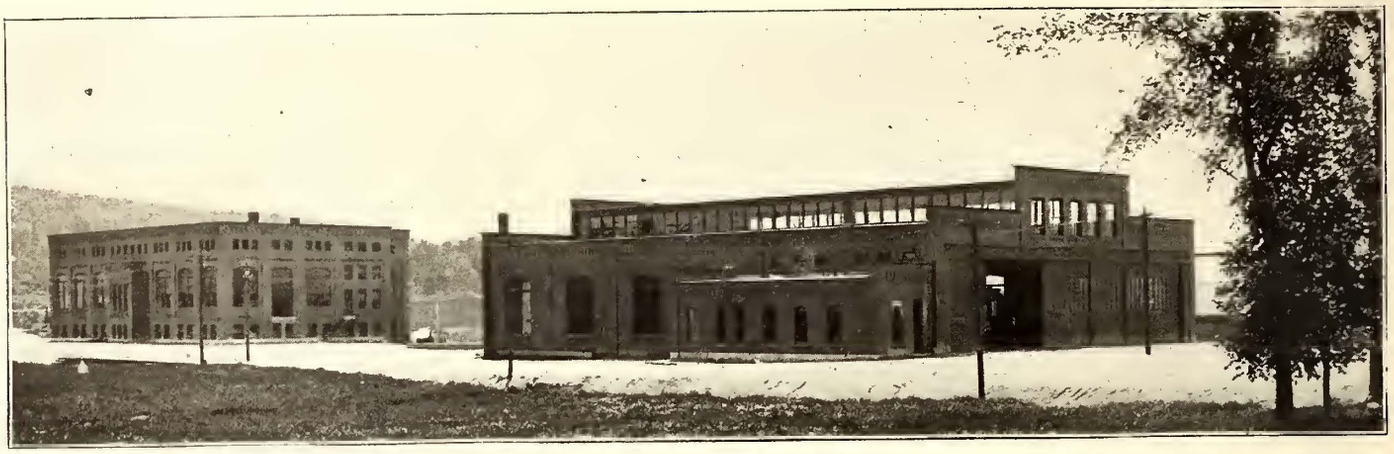
This task included the building of 3½ miles of new streets in the towns of Auburn and Oxford, with roadbed of gravel, bridges of steel I-beams, with 60-lb. steel rails, 60 ft. long, on 7-ft. chestnut ties, and equipped with 00 copper trolley wire, 500,000 circ. mil, rubber covered and 0000 copper feed wire, with turnouts about 350 ft. long and automatic switches. The ties are chestnut, 5 ins. thick x6ins.face, and are spaced 2 ft. centers. The joint plates are the standard four-bolt, 24-in. angle bar. The bonds are all No. 0000, about one-half being of the Protected type, the others being Crown bonds. The poles throughout are of chestnut, 30 ft. long and 10 ins. in diameter, 5 ft. from the butt, except in the village of Oxford, where octagonal hard pine poles 30 ft. long are used. The overhead material is of the West End type, with General Electric switches and flexible brackets.

The company has a fine location in the town of Oxford

for the power station and car house, on a lot of land situated between the main street and the N. Y., N. H. & H. R. R., consisting of about 3 acres, with a frontage of railroad of about 100 ft.

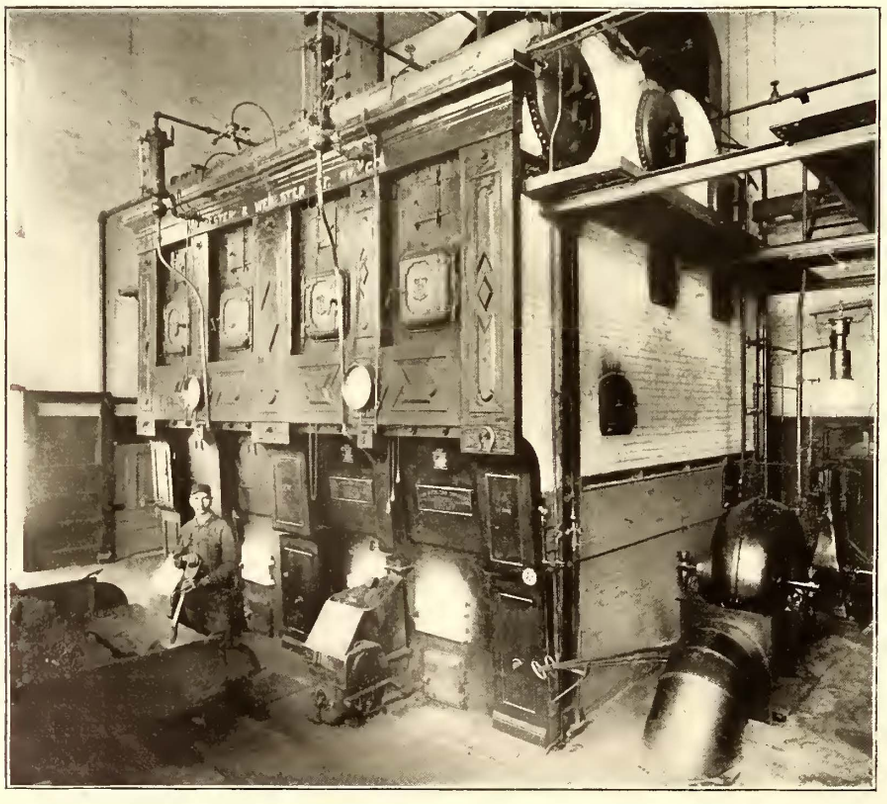
The power station is of brick with granite and brownstone trimmings, as shown in the engraving. The engine room floor is of steel with brick arches and granolithic top. draft is automatically regulated by a very unique arrangement, consisting of a Spencer damper regulator attached to the blower engine steam valve.

The pump room is a separate compartment 12 ft. 6 ins. x 18 ft., equipped with one large duplex Blake pump for use in filling the feed-water heater, and the entire water system for both the power station and car house is ar-

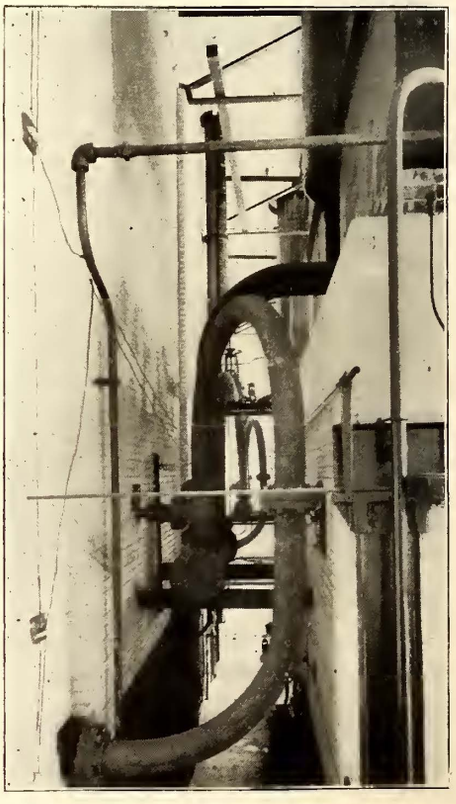


POWER STATION AND CAR HOUSE

The boiler room floor and the floor under the engine room is of 4-in. Portland cement concrete, and is absolutely fireproof. Owing to this construction it will not be necessary to carry any fire insurance on buildings or equipment. The power equipment is about 1000 hp. with buildings large ranged to work automatically and to maintain a pressure of from 100 to 150 lbs. For emergency use, one smaller and two larger pumps are used, each of the latter being capable of feeding the large boilers from the Cochran heater, which heats the water from 210 to 212 degs., by



BOILERS AND UNDERFEED STOKER



HEADERS AND MAIN

enough to double the capacity when needed in the future.

The boilers are of the Stirling water-tube pattern, fitted with the American under-feed stoker, which has proved very satisfactory on other New England roads. The company also uses mechanical draft, having installed a No. 9 Sturtevant blower directly connected to a small steam engine. By this means no large stack is needed and the economizing the exhaust steam from the pumps and condensers.

The steam piping is of bent pipe, all put in by the Carman, Thompson Company, of Portland, Maine, and there are three distinct ways of feeding the water to the boilers, so in case one should become defective there are two other ways of supplying water.

The engine room is complete in every particular, fur-

nished with two direct-connected, cross-compound Hamilton-Corliss engines of 600 hp each, of 120 r. p. m., and two 275 kw direct-connected Westinghouse generators on foundations 12 ft. high, built of brick all laid and puddled with Portland cement on 18 ins. of crushed stone and Portland cement concrete. The entire building is fitted with hot and cold water and open plumbing. The gravity oiling system is used, the oil running on the bearings all the time and then passing through a pipe to the filter, where it is filtered, pumped to tank and used over again.

The coal pocket, of the steam railroad trestle pattern, is large enough to hold 25,000 tons of coal. The coal descends through chutes to hand cars which run on a track passing through the boiler room in front of the boilers. The boiler room is also connected with the main line of track for the removal of cinders and ashes to the roadbed by the construction car at one operation.

The car house, which adjoins the power station, is of brick with brownstone trimmings well arranged and ample for the purpose, having seven tracks and a "Y," including front sliding doors hung at the top, and the trolley wire is arranged to extend whole into the house without cutting. The office, conductors' and motormens' headquarters are furnished with all necessary appointments. The plans for the station and car house were drawn by J. William Patston, architect, of Worcester, Mass.

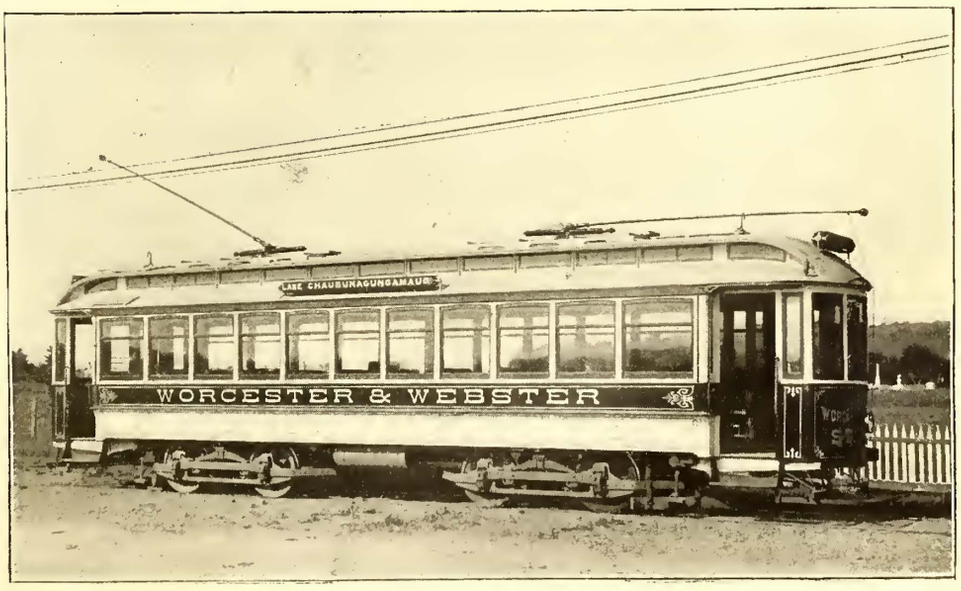
INTERIOR OF CLOSED CAR

INTERIOR OF CAR HOUSE

The company has reason for great pride in its rolling stock, which consists of seven handsome box or closed cars, about 43 ft. long. They are finished in quartered oak inside, with plush cross seats, and each has a capacity of from forty to forty-four people. There are eight fifteen-bench and two twelve-bench open cars. The cars, which are illustrated herewith, were built by the Laconia Car Company Works, of Laconia, N. H. All the cars are mounted on Laconia double trucks, with the motors suspended outside the axles. International registers are used.

Each car is equipped with two 50-hp Westinghouse high-speed motors and Standard Air Brake Company's axle-driven air compressor brakes and chime whistles, and the new Carpenter sand box, the invention of E. E. Carpenter, of the New England Electric Railroad Construction Company.

In addition to the electric push-button signal for stopping, each car carries a telephone, which allows the making of connections to the car house from any point on the line. This is accomplished by using a telephone wire running the entire length of the line, and di-



STANDARD CLOSED CAR

rectly connected with the car by a bamboo pole properly wired. The cars are not dispatched by telephone, but in case a car is delayed and obliged to wait at a turnout, the conductor can call up the main office and receive orders as to whether to wait or go ahead, thereby avoiding any liability of accident by trying to steal switches.

The road is also furnished with a large construction car equipped with motors and all electrical appliances for repair work or in case of accident; also two Taunton snow plows.

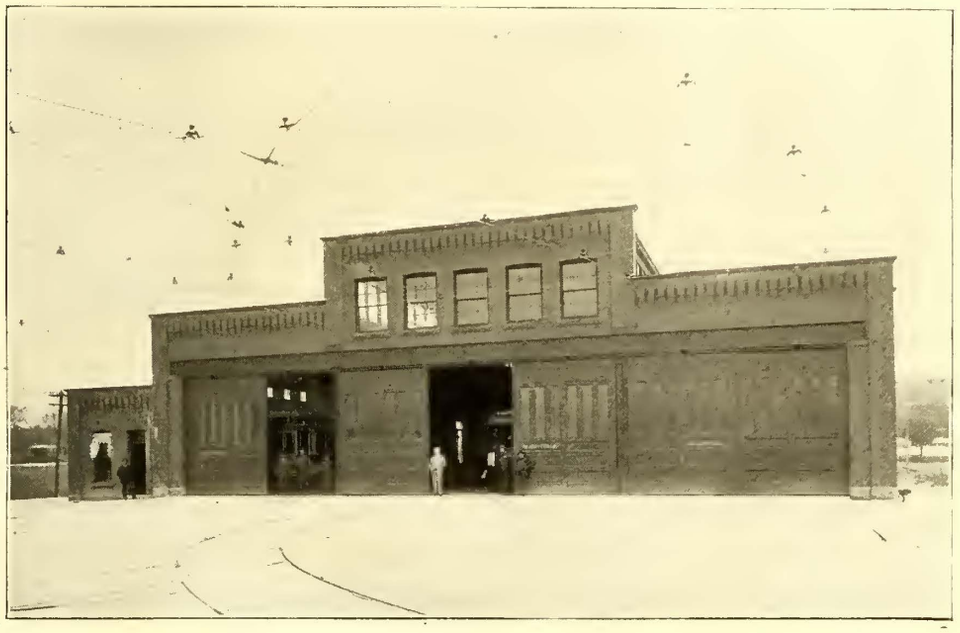
A parlor car is now building from special designs which is to be one of the finest of its kind ever built. It is 45 ft. long, with parlor, smoking room and toilet compartments with buffet and refrigerator appointments. The finish is mahogany with artistic carvings, bevel plate glass and art glass, mirrors and windows, and has a seating capacity of twenty-four luxurious parlor chairs, both cane and upholstery. These, with electric push-buttons, call bells and telephone system, make this palatial car one of the finest of its kind in the country.

Although the line has been in operation but a few months, it already has a large through and local patronage and is destined to be the popular route for quiet pleasure seekers as the season advances. As stated, the total cost of construction and equipment of this line, which is about 17 miles long with turnouts, was about $400,000. Of this amount the roadbed and track cost about $110,000; the special work, grading, switches, frogs, new streets, fenc-

VIEWS ON LAKE CHAUBUNAGUNGAMAUG

ing, etc., about $60,000; the overhead materials, including poles, brackets, feed-wire, trolley wire, etc., about $48,000; the rolling stock, about $47,000; the car house, complete, about $22,000; the power station, about $30,000; the land, well, grading, etc., about $8,000; the power station equipment, about $70,000; the miscellaneous items, such as office furniture, telephone system, tower wagon, etc., amounted to about $5,000.

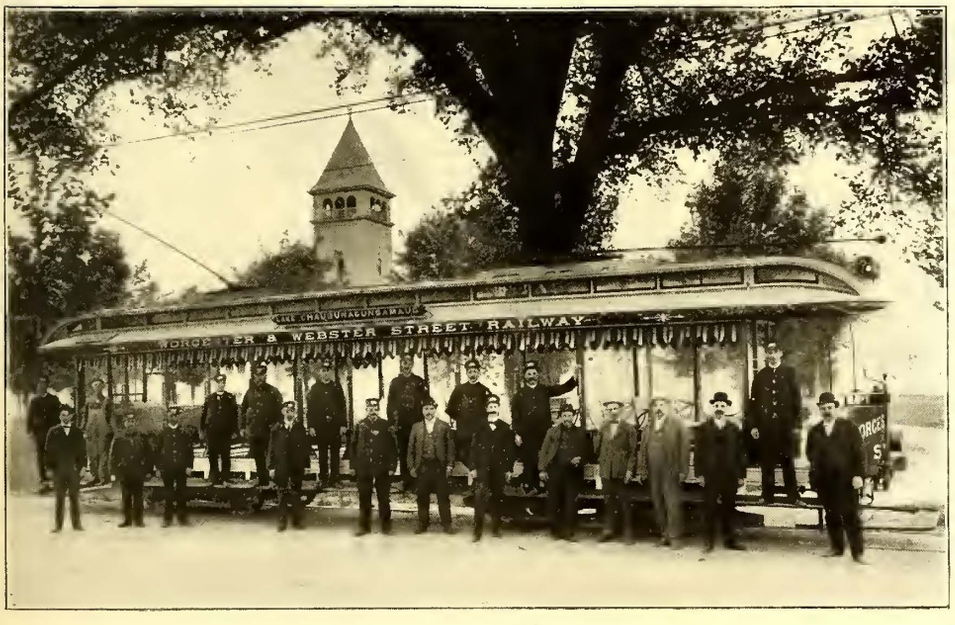
The officers of the company are Julius Garst, president; Fred Thayer, vice-president; W. A. Bailey, treasurer; E. L. Parker, auditor. The construction, as stated, was performed in its entirety by the New England Electric Railroad Construction Company, of Worcester, Mass., of which Mr. Carpenter is head, and H. F. Leland the clerk and treasurer. With Mr. Carpenter were associated Charles A. Midddlemas and H. F. Lincoln, the constructing engineer of the New England Electric Railroad Construction Company. These gentlemen have received many compliments upon the very successful manner in which this road has been equipped.



CAR HOUSE

Testing Public Opinion in Chicago.

The agitation over changing the motive power on the lines of the Union Traction Company, of Chicago, led to a novel test of public sentiment June 19. Baskets were put on the cars and each basket had beside it an invitation for each passenger to place in it a ballot expressing his opinion upon the present system of transit. The inquiry was made by the North Side Business Men's Association. The result was that 3802 voted in favor of the overhead trolley, and only a few cast ballots for other methods of transportation. This is a pretty good indication of the satisfaction given by the trolley system, as compared with the other methods employed in that city



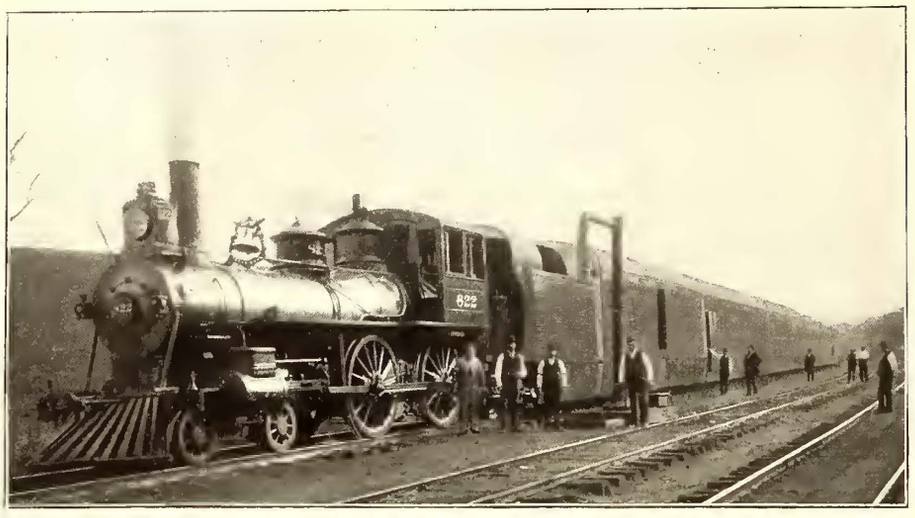
VIEW OF CAR AND OPERATING FORCE

German Managers to Make a Trip of Inspection to America

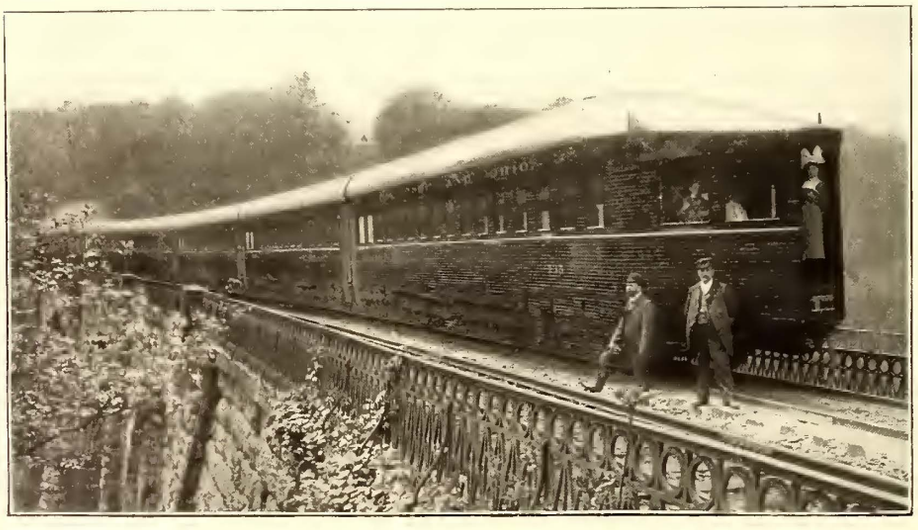
Under the auspices of the Verein Deutscher Strassenbahn und Kleinbahn Verwaltungen, which is an association comprising the principal street railway companies of Germany, an extensive trip of inspection will be made by a number of members of that association to the United States next year. The object of the trip is to study the latest developments of electric traction, both surface and elevated, in the different cities. From twenty to twenty-five gentlemen have already signified their intention of joining the party, and it is thought that the advantages of the trip, as showing the latest developments of American practice in electric railroading, will appeal so strongly to other members of the association that before the date of starting the party will comprise representatives from practically all of the larger cities of Germany, as well as of some of the larger manufacturing companies. The party will leave Germany during the early part of May, 1901, by either the Hamburg-American or North German Lloyd line, and New York will be the first city visited. Other cities which the party is planning to visit are Boston, Cleveland, Chicago, St. Louis, Cincinnati, Washington and Philadelphia. The entire trip will occupy from six to seven weeks, of which from fifteen to seventeen days will be occupied by the ocean voyage. The party will spend one day at Niagara Falls on the trip between Boston anod Chicago. The cost of the trip, including the steamship travel, railroad fares, etc., is estimated at about M3,000 per person. This is considered an outside figure, and should include all expenses. Heinrich Vellguth, secretary of the association, has the details of the trip in charge.

Form of Train for Reducing Air Resistance

Although somewhat outside of electric railroading the experiments now being carried on by Frederic U. Adams on the Baltimore & Ohio Railroad, in an effort to reduce air resistance, will be of some interest to workers in high speed electric railroading, whether the results prove successful or not. A great many attempts have been made to reduce this part of a train's resistance, a factor which, at high speeds, is undoubtedly a very important one. The subject was quite thoroughly discussed in a series of articles in the STREET RAILWAY JOURNAL about a year ago, in which one writer, Henry Graftio, formerly chief engineer of the Heilmann Company, of France, stated that he believed that a form of train in which the spaces between the cars were closed, and the front and rear of the train were provided with shields, shaped somewhat like the bow and stern of a boat, would appreciably reduce the air resistance of the train. The closing of the spaces and the shape of the rear car were considered more important than the pointed shape of the front end of the train. This opinion coincides with the views held by Mr. Adams, who has been working on the subject for the last ten years.



FRONT END OF TRAIN



REAR END OF TRAIN

In the tests made with the train shown it is claimed that a considerable reduction in train resistance has been secured, and a gain of from 7 to 10 miles an hour was made with the same engine over the same tracks, drawing the test train, and also a standard train with the same number of coaches. No very accurate measurements of power, however, have as yet been obtained, so that it is impossible at the present time to predict what the saving will be, if it is practically anything. It is understood that a special dynamometer car and tender are in process of construction, and when experiments are made with this apparatus greater knowledge can be had as to the practical value of the device. It seems to be generally admitted that the pulling back action of the last car is one of the principal factors in train resistance. It would be interesting to place the dynamometer car both ahead of the cars and in another test just ahead of the rear car, and thus determine whether the shape of the rear car on Mr. Adams' train actually lessens the train resistance. It is needless to say that the reduction effected is only that produced by the air resistance ahead, and that the train resistance caused by flange friction produced by a side or quarterly wind is not reduced by the form of the train.

In the train, as now constructed, the tender is built up to the height of the car so that there is no break between the engine cab and the baggage car. The windows are set flush with the sides of the car. The sides of the cars extend down so as to nearly enclose the trucks and to prevent the air from impinging against them. The platform doors extend to the bottom of the steps, and are flush with the sides. The spaces between the cars are closed with flexible connections which accommodate themselves to all curves and the various complex motions of a train at high speed. The roof is arched and is perfectly smooth. The rear car tapers to a point. In the train now being tested nothing has been done to the engine, as Mr. Adams decides to show that the cars are the greatest violators of the laws of speed.

The second novel feature is the ventilating system. All the air for ventilation is admitted from the front end of the tender, where there is an absence of smoke or dust. It is carried along passages in the roof, which connect when the cars are coupled. From these ducts the fresh air is distributed through the train.

United States Consul McGinley at Athens writes, under date of May 14, 1900: "From reliable sources, I have learned that the Athens and Piræus Railway Company must, according to conditions in its franchise, adopt electricity as the motive power for its trains within the next three years. This road extends from the quay in Piræus to the business center of Athens, some 5 miles, three-fourths of a mile of the distance being through a tunnel under a portion of the city. A Belgian company which owns and operates a steam tramway between Athens and Piræus, via Phaleron, also wishes to adopt electric power for its trains; but how soon it desires to make the change has not been learned. Each road has a very large passenger traffic, especially in the summer season.

The Largest Electric Railway Company in Germany

Berlin, which, with its suburbs, has a population of 2,400,000 inhabitants, has a system of transportation which is the most complete in Germany, and ranks high compared with that in any other metropolis. The long distance traffic and that between the various steam railroad stations is cared for by the Stadt- und Ringbahn. This line has thirty-five stations. Its total length (measured as single track), is 65.17 km. (40.4 miles), of which 13.58 km. (8.4 miles) and fourteen stations, belong to the Stadtbahn. As the road is to a large extent elevated on stone arches through thickly populated city districts, great difficulties were encountered during construction, which easily explains the enormous capital investment of M.110,000,000 ($27,500,000) for its construction.

The most important institution for the local traffic of Berlin, and at the same time the largest undertaking of its kind in Europe, is the Grosse Berliner Strassenbahn, which has a stock capital of over M.67,000,000 ($16,750,000). On this road, including the Westliche und Sudliche Berliner Vorortbahn, 223,700,000 people were transported last year, and its cars, exclusive of trailers, traveled 22,300,000 km. (13,726,000 miles). About one-half of this road is operated by electricity, and probably not later than two years from now this will be the only motive power.

Besides the above there are other electric roads operating in Berlin, notably the Berlin-Charlottenburger Strassenbahn, the most important section of which was at first operated by accumulators only, but on part of which the overhead trolley has been installed. This company has also decided to supplant the horse on all its lines by electric power, and the order to do this has already been placed with Siemens & Halske. The same firm also constructed the Berlin Elektrischen Strassenbahnen, a portion of which (2.1 km) is operated by underground trolley, and another portion (16.3 km) by the overhead trolley.

On Oct. 21, 1899, another road, built by Schuckert & Company, was opened to the public. This road, which is 6.6 km. (4.1 miles) in length, carries freight as well as passengers, and is equipped entirely with the overhead trolley. The Stadt- und Ringbahn, already referred to, is the only existing elevated road in Berlin, but as early as 1891, Siemens & Halske submitted a design for an electric elevated road, and at the same time the Allgemeine Elektricitäts Gesellschaft formulated a plan for a connecting system of underground railways. The first proposition received Imperial sanction on May 3, 1893, for the section Warschauer Strasse-Nollendorf Platz, and work was begun in 1895 after much wrangling with the city in regard to the charter. The greater part of the road has already been completed, and the company formed for the construction of the road believes that the entire line from Warschauer Strasse to the Zoological Garden will be completed in 1901. Part of this line will be built underground, the other part elevated.

The permission to build a deep underground road has not been granted up to date, but the Company for the Construction of Underground Roads was able to celebrate on Sept. 1, 1899, the successful completion of the Spree Tunnel. This tunnel, which leads from Stralau to Treptow, is remarkable in many respects. It is the first underground passage which in its entirety is built in quicksand, and the first in Germany to be excavated exclusively by means of the breast shield. The electric road, which utilizes this tunnel, starts from the Schlesische depot, passes through Stralau, and ends at Treptow, and in the tunnel a speed of 13.5 km. per hour is attained.

Besides the surface cars several omnibus companies take care of the traffic of Berlin, and there is also a well organized cab system. At the beginning of 1899 there were in service 231 omnibuses and 8096 cabs. Omnibus and cab owners are at present experimenting with automobiles. Whether it will be possible to train a set of men so that they can operate these vehicles, especially heavy busses, without danger to the pedestrians, through the crowded streets of the Metropolis is a question which the future alone will answer.

To describe all these various means of transportation in vogue in Berlin, however, is not the intent of this article, but to consider only the most important road, namely the Grosse Berliner Strassenbahn. Nor will the history of this road, which was founded in 1871, be considered. Those who are interested in this aspect of the question are referred to a very excellent pamphlet on this subject, entitled "Twenty-Five Years of the Grosse Berliner Strassen-

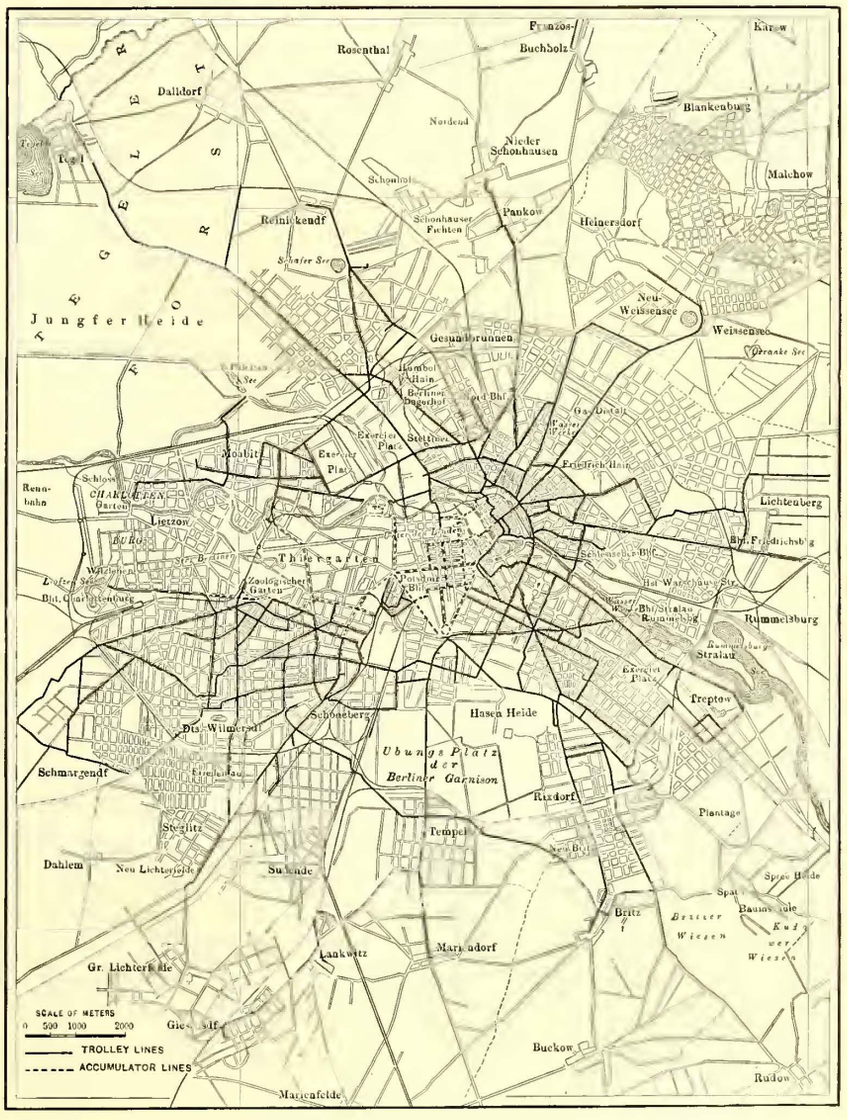


FIG. 1.—MAP OF BERLIN, SHOWING THE LINES OF THE GROSSE BERLINER STRASSENBAHN

bahn," published by Bergmann, Wiesbaden, in 1898. The present article will be limited, therefore, to the introduction of electricity on the road, and to its status at the close of the past year.

The Grosse Berliner Pferdeeisenbahn A. G., as the present Grosse Berliner Strassenbahn was called until the beginning of 1898, made experiments with accumulator cars, the so-called Reckenzaun system, as early as in 1884 and 1885. The batteries, however, were not commercially reliable, so that after a short time the cars were dismantled and horses were again employed. Electrical experiments were then discontinued until soon after the opening of the Berlin Industrial Exhibition in 1896, when the managers of the road succeeded in obtaining permission from the city to introduce electricity, using the overhead trolley on several of its lines, which were being greatly crowded, due to the Exposition. The Union Elektricitäts Gesellschaft was asked to furnish fifty motor cars, and to equip several lines. The work was pushed vigorously, and when the Exposition was opened on May 1, 1896, a part of the system was in operation, the remainder being ready by June 29 of the same year.

The year 1896 might be called the experimental year for the introduction of electricity as a motive power on the Berlin street railways. The overhead system amply met the extraordinary demands made upon the road by the Exposition crowds, and was shown to be far superior to horse power for the transportation of large masses of people.

In December, 1897, negotiations leading to a definite introduction of electricity on the entire system of the Grosse Berliner Strassenbahn were finally brought to a close, due to the granting of the Emperor's consent, and motor cars were ordered at once, and the equipment of the line was begun. The execution of the work was intrusted to the Union Elektricitäts Gesellschaft, and was superintended by its engineer, Mr. Bjorkegren, who also supervised the construction of the Bremen and Hamburg roads, the latter ranking in size after that in Berlin, and well-known on account of its superior equipment and operation.

FIG. 2.—VIEW AT ALEXANDER PLATZ, SHOWING SPAN WIRE CONSTRUCTION

As the use of the overhead trolley was not permitted in the central and western portion of Berlin, it was decided to introduce the so-called mixed system on these lines, in which the battery is charged while the car is on the portion of the road equipped with trolley, and furnishes currrent for the motors on those portions where the trolley is forbidden. It should be added, however, that recently several of these branches originally equipped with the mixed system are now operated entirely by trolley.

On March 1, 1898, the Schöneberg-Alexander-Platz line was opened. It is 7.1 km. (4.3 miles) in length, 3.4 km. (2.1

miles) of which is operated by means of accumulators. On this line the double truck cars were first used. On May 11 followed the opening of two other lines, and in the following summer and fall four more lines, among which was the 14 km. (10.5 miles) belt line. As a result, the car mileage just about doubled.

In 1899 the electrification of the road was contiued with even more energy, so that at the close of 1899, nearly one-half of the city, and over one-half of the suburban lines, are electrically operated. The equipment is divided as follows: Overhead trolley, 105 km. (65 miles); accumulators, 16.5 km. (10.2 miles). Measured as single track the entire system now operated by electricity consists of 244 km. (151.3 miles), on 34 km. (21 miles) of which accumulators are used. When completed the system will comprise about 475 km. (294.5 miles) of track. In 1899, 13,910,000 kw-hours were consumed, and 22,278,835 motor car and trailer km. (13,812,678 car miles) were traveled. In these figures the results of operation of the Neue Berliner Pferdebahn-Gesellschaft, as well as the Westlicher und Sudlicher Berlinen Vorortbahnen have been included. The first named company was amalgamated with the Grosse Berliner Company early in 1900, and the same management operates all three roads.

By far the greatest portion of current used by the road is purchased from the Berlin Electric Works, the rest being purchased from Schöneberg Electric Works and the Charlottenburg Electric Works. From July, 1898, to July, 1899, Berlin Electric Works furnished 28,893,947 kw-hours, of which 35 per cent were used for the operation of the road. The Electric Works in each case supply the feeders, and the current is measured at the point of feeding to the trolley wire. There are a total of seventy-seven feeding points at present. At each two wattmeters are located, from which the current consumption is computed, one meter being placed there by the works furnishing the current, and the other by the management of the road. Fig. 12 shows a section box, in which two such meters of different types have been placed.

The several sections supplied with current are separated from each other during normal operation by section insulators, but they can be connected together by means of switches. The trolley wire is also separated into sections every 500 meters, these sections are ordinarily bridged by a section cut-out. At crossings the section cut-outs are close together, and are never more than 100 meters from the crossing.

FIG. 3.—TYPICAL STATION, BERLIN ELEVATED RAILWAY

The trolley wire is of hard drawn copper, is 8 mm in diameter (No. 0 B. & S.) and is supported every 35 m to 40 m. The insulator is of the "West End" pattern, which was used here in Europe for the first time. Up to date, about 4700 tubular poles and 200 built-up poles have been placed in position, as well as 4000 rosettes with noise dampeners. As in most German installations, special care was taken to design and use poles which would thoroughly harmonize with their surroundings, and in Fig. 6 is shown the type of pole and arm most commonly seen in Berlin. The built-up type, also shown, is employed only in suburban districts and along sparsely populated streets. At certain points, special poles, with double candelabra, designed by

the royal architect, Schwechten, have been placed, as in front of the Emperor William Memorial Church. The designs of rosettes also correspond to the architecture of the buildings to which they are attached. That the noise dampeners which are used in connection with the rosettes work effectively, by the use of gutta percha insulation, is shown by the fact that of the 4000 rosettes installed, not more than thirty had to be removed, and this on account of a change about to be made on the building or because the building itself passed into the hands of owners who wished them removed.

The trolley wire is suspended 6 m (19 ft. 6 ins.) above the heads of the rails, but this distance is decreased to 4.5 m (14 ft. 10 ins.), the smallest permissible height under bridges and railroad spans, as shown in Fig. 11. The greatest span within city limits was necessitated at the Jannowitz bridge, where the distance from pole to pole is 80 m (262 ft.). In Fig. 5 is shown the method of suspension adopted in crossing the Colonnen bridge, the span being 100 m (328 ft.) in length.

The current is returned through the rails, which are bonded by means of copper in the usual manner adopted by the Union Company, and specially laid cables. The change to electric traction necessitated the replacing of a large number of rails, such as the Larson, Fischerdick, Haarman and 13-cm (5-in.) Phœnix by rails of more modern design. The standard rail used is of the Phœnix girder type 160 mm (6¼ ins.) high, with central web 11 mm (0.43 in.) thick. The lip is only 15 mm (0.6 in.) in width, and on new rails lies 3 mm (0.12 in.) below the running face. The lip was designed narrow, so that wagons passing over the rail would wear all parts of it equally, and thus a step formation would be prevented. The section finally adopted was the result of this company's long experience, and was rolled after the design of the royal engineer, Mr. Fischer-Dick. Most of the track is laid in concrete, and where this was impossible, on a bed of gravel, as shown in Figs. 56 and 7. The rails are nearly all joined by means of the Schmidt half-lap fish-plate, in which 50 cm (20 ins.) of the angle-plate is countersunk into one-half the rail-head at the joint. Since the beginning of 1898 the Falk cast rail-joint has been used on several portions of the road to a considerable extent, as has been described in these columns.

Besides the rails, nearly all the special work had to be replaced. That at present is mostly of the made-up type. The shortest radius of curvature is 16 m (53 ft.), the steepest grade is 4 per cent.

The underground conduit electric system is not in use at present on the road, nor is there a single instance of a simple accumulator system; the lines have the overhead trolley either on part of or on their entire length, or else the mixed system, where the battery furnishes current only along those portions where there is no trolley wire.

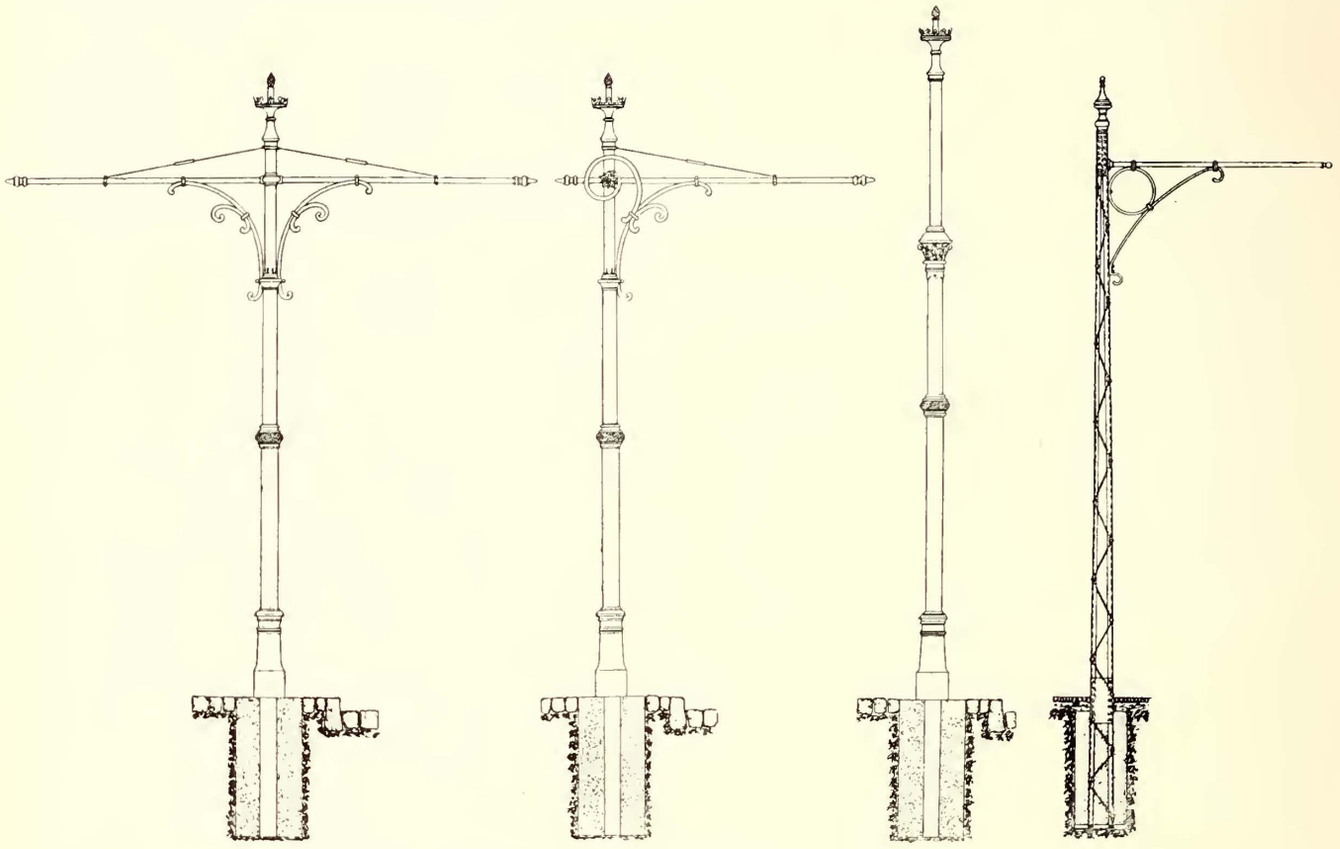


FIG. 4.—TYPES OF TUBULAR AND LATTICE POLES USED

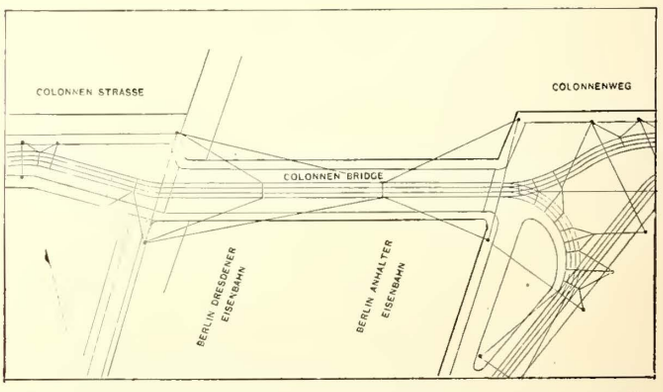


FIG. 5.—METHOD OF SUPPORTING TROLLEY WIRE WITHOUT POLES, ON COLONNEN BRIDGE (328 FT. LONG)

The accumulator system, which requires neither an expensive roadbed, like the conduit system, nor the overhead construction, is generally believed by the general public, to be the most perfect of all electrical systems, but, in addition to the weight, the acid fumes from the battery

have been found in Berlin to be offensive, in spite of the great care exercised in guarding against their escape. The separate cells must be completely cleaned out from time to time, and even then the experience in Berlin has been that the escape of gas cannot be avoided. Moreover, even in a comparatively new cell, the superoxide deposit which gathers on the plates causes a local discharge of the cell, thus greatly reducing its efficiency. Again, if the traffic is not quite normal, the time during which the cars are on the trolley sections is not sufficient to charge the cells so that they can carry the car over the sections where there is no trolley wire. It was also found on Dec. 11, 1899, in again using the accumulators for the first time after a heavy fall of snow, that they were far from satisfactory. All the stoppage and delays, the most serious which the road had encountered for ten years, were caused by the accumulators failing to meet the traffic demands. Besides, the expenses to maintain such a system are considerably increased. It was originally thought in Berlin that the accumulator (mixed) system would cost 6 pf. per km (2.4 cents per car mile) more than the overhead system, but it was found that this figure had to be increased 40 per cent. For an extensive overhead system the use of accumulators is rather a disadvantage, as the weight of the battery (2.8 tons on large cars) has to be transported along the entire distance as a dead load. On several lines where the traffic is densest and delays must be avoided at any cost, the city authorities have recently permitted the provisional installation of the overhead trolley, where formally its use was prohibited.

Another change necessitated by the adoption of elec-

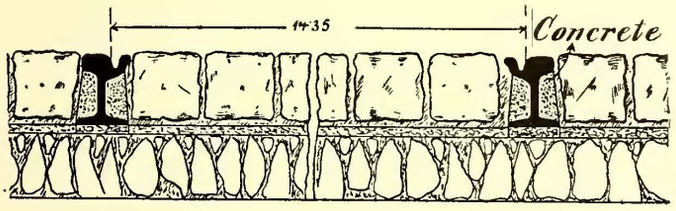


FIG. 6.—TRACK CONSTRUCTION IN BLOCK PAVING

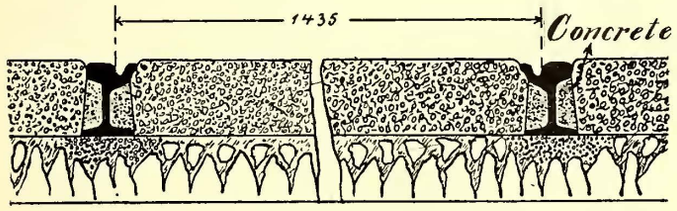


FIG. 7.—TRACK CONSTRUCTION IN MACADAM PAVING

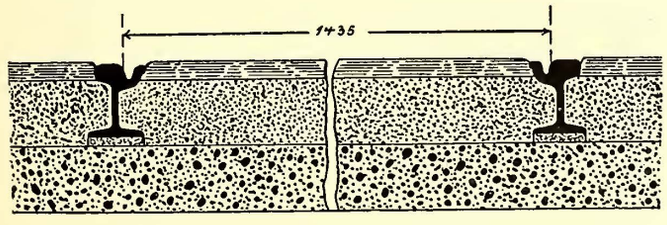


FIG. 8.—TRACK CONSTRUCTION IN ASPHALT

tricity as a motive power was the extension of the rolling stock. For the two lines opened in 1896 only fifty motor-cars were purchased, each being equipped with two motors of 13.5 hp, using 28 amps. At the close of 1897 the report of the company showed an ownership of only fifty-five motor-cars. One year later this figure rose to 375, 202 of which were designed for mixed service. At the close of 1899 the company owned 300 cars for mixed and 400 for the simple overhead system. For the complete road, as now planned, at least 1200 motor-cars will be required, 600 to 700 of which will probably be equipped with accumulators. Fifty cars were bought in America in order to obtain American designs; the remainder were of Ger-

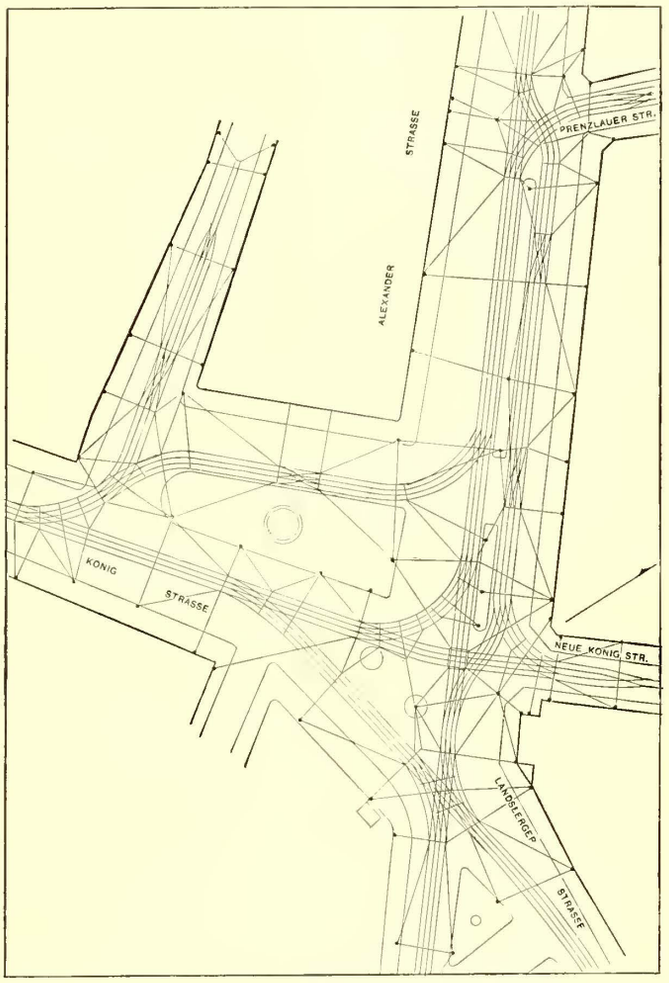


FIG. 9.—DIAGRAM OF OVERHEAD WIRING AT ALEXANDER PLATZ

man pattern and made in Germany. The two types differ mainly in the frame construction and the arrangement of the truck springs. The so-called St. Louis cars have cross seats, but these are not well adapted for Berlin street service, as the cars on several lines are only 2 m (6 ft. 6 ins.) in width, which is hardly sufficient for this type of car.

The trucks were furnished by the Bergische Stahl Industrie. The side frame for the single trucks, which are of the "model Berolina," are large steel castings united by flat iron cross-bars. The wheel-base on the single trucks is 1.750 m (5 ft. 9 ins.), and on the double trucks, 1.400 m (3 ft. 7 ins.) The double trucks were designed by Chief Engineer S. Peiser, of the road, who also drew up the plans for the car bodies and single trucks.

The new cars are equipped with two motors, which are protected, as are all the car-motors manufactured by the Union E. G., by a completely closed magnetic field. Each motor weighs 785 kg, has a capacity of 23 hp, and consumes 44 amps. The power is transmitted to the driving axle and cast steel wheels by means of gearing, at a ratio of 1:4.78.

The braking can be accomplished either by a hand or an electromagnetic brake similar to the General Electric brake, well known in America. The necessary current is

furnished by the motors, which are momentarily transformed into generators. The electrical braking of the trailers is accomplished by the current acting on an iron core, which, by means of a system of levers, operates the brake-shoes of an ordinary hand-brake. The latter can, however, also be operated by the motorman without affecting the electromagnetic device, so that these cars can be used either as horse cars or trailers.

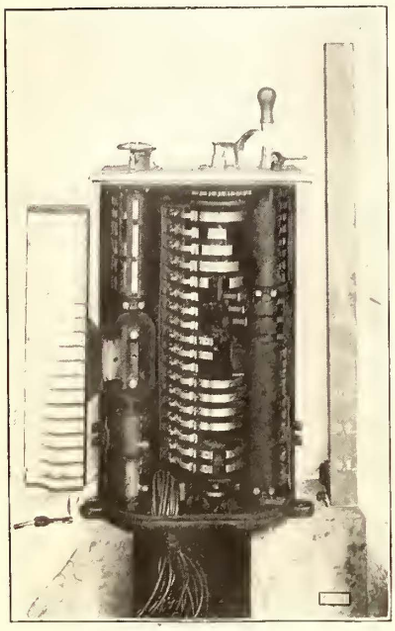


FIG. 10.—CONTROLLER WITH ELECTRIC BRAKE ATTACHMENT

The controllers for the simple trolley cars are of the series-parallel type, with electric brake attachment. Those for the mixed system cars are provided with a supplementary cylinder and small hand-wheel, by means of which the following combinations may be obtained:

1. The motors are connected with the trolley and the battery is being charged.
2. The motors are connected with the trolley and the battery is cut out.
3. The battery is connected with the motors and the trolley is cut out.

The trolley-pole is of the standard under-running type. In cars designed for the mixed system the pole may be let down onto the roof of the car.

The accumulators of Majert type, which were nearly all furnished by the Accumulatoren-werk Oberspree Niederschönweide, are situated under the two rows of seats in the cars. The first batteries were furnished by the Accumulatorenfabrik A. G., Berlin. The cells are provided with slugs, by means of which they are singly suspended on a wooden strip, which is a part of the car-body, and which is covered with hard rubber. Spilt acid can run off freely through openings in the bottom. Air is admitted into the accumulator space through four ventilating pipes in each corner of the car, which lead up through the roof and there end in a suction head. The double-truck cars contain 200 cells, which can furnish 30 amp.-hours at a one-hour discharge, and the single-truck cars contain 200 cells, having a capacity of 25 amp.-hours also if discharged in one hour. Although the longest portion of the road, along which there is no overhead trolley, is only 5 km (3.1 miles), the large types of accumulators have been chosen, as smaller ones would soon go to pieces, due to the large charging and discharging currents and the current consumption, which rises to a considerable amount during unfavorable weather conditions. The time for charging varies according to the time during which the battery was last discharged, from three to ten minutes. The charging current is 180 amps. at the beginning, dropping quickly to 100 amps., and then gradually decreasing in a straight line to 5 amps. The discharge current has an average value of 40 amps., but rises at times to 250 amps. These values relate to the larger types; for the smaller types the currents are about 70 per cent of the above. An ammeter is placed in the accumulator circuit, which shows whether the battery is charging or discharging.

FIG. 11.—PASSING UNDER BRIDGE WITH 14 FT. 10 INS. HEADROOM

There are ten incandescent lamps to furnish light in the cars connected in series of five each. They are supplied with current from the battery, 170 cells being necessary for that purpose when the trolley is in use, all of them, however, when they are being discharged.

The large cars have seats for twenty-eight, the small ones for twenty passengers, and there is standing room in each car for twelve people. All cars are equipped with a sand-box, and in the newly equipped cars the sand is thrown in front of the two forward wheels.

The first motor-cars were stored in the old, renovated car houses of the company, in the Manteuffel and Münberg Streets. In 1897 the depot in the Brandenburg Street was torn down and in its place a modern car house holding sixty-three motor-cars, and a small repair shop, was erected. During the course of the last few years a large part of the car stables were transformed into motor-car houses, and several new depots, designed exclusively for motor cars, have been constructed. A larger repair shop, in which one hundred cars may be repaired and 150 more stored at the same time, has been built in Ufer Street, where the new cars are also equipped with motors. In this connection it might be stated that the depots, which at the beginning of 1899 offered room for nearly 1100 horse cars and 6000 horses, will, within one and one-half years, all be transformed into houses for the housing and repairing of motor-cars. By the time the work of transformation is completed the company itself will own in round figures 1200 motor-cars, to which should be added one hundred motor cars belonging to other companies.

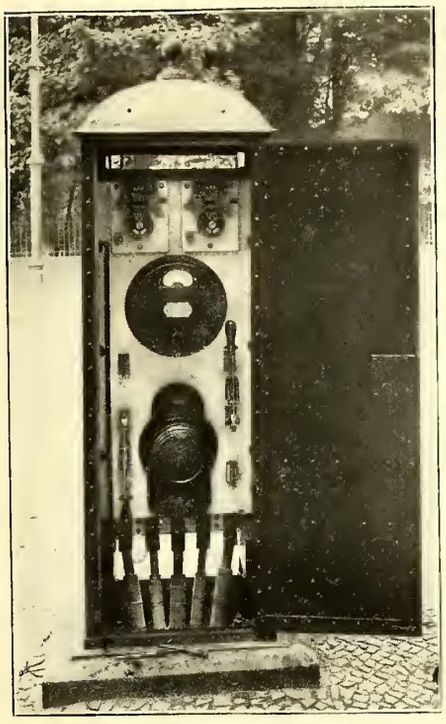


FIG. 12.—SECTION BOX WITH TWO WATTMETERS FOR MEASURING CURRENT FLOW FROM FEEDERS TO TROLLEY

In Berlin it is difficult to talk about a center of traffic; the various squares and markets rival with each other to become the most popular. Take, for example, the Alexanderplatz, from which emanate and through which cross twenty car lines with 150 cars an hour. A plan of this square is shown in Fig. 9 and a view of it in Fig. 2.

The Vincennes Exposition Railroad

[*From Our Regular Correspondent.*]

The Paris Exposition is divided, as most readers of this paper know, into two sections, this arrangement being determined upon by reason of lack of available space within the city limits. The annex is situated at Vincennes, about 6 miles distant from the main grounds, and is practically isolated, inasmuch as there is no adequate system of transportation between the two sections, and a single entrance ticket will not give admission to both. A partial solution of the transportation problem has been secured by providing a "temporary" double-track trolley road, which follows the line of the fortifications past the Bois de Vincennes, branching out into a loop at the main entrance to the Exposition grounds, and forming connection at one end with the Nogentais tramway system and at the other with the river steamboats. This line has been constructed by the French Thomson-Houston Company, under the supervision of its engineer, A. N. Connett, and was put in operation for the first time on May 12. It is doubtful whether it will be a paying property at first, as the Vincennes annex gives but little indication of becoming a really popular resort. The track races will doubtless draw a crowd; but during the show there will always be a

FIG. 2.—VIEW SHOWING POLES

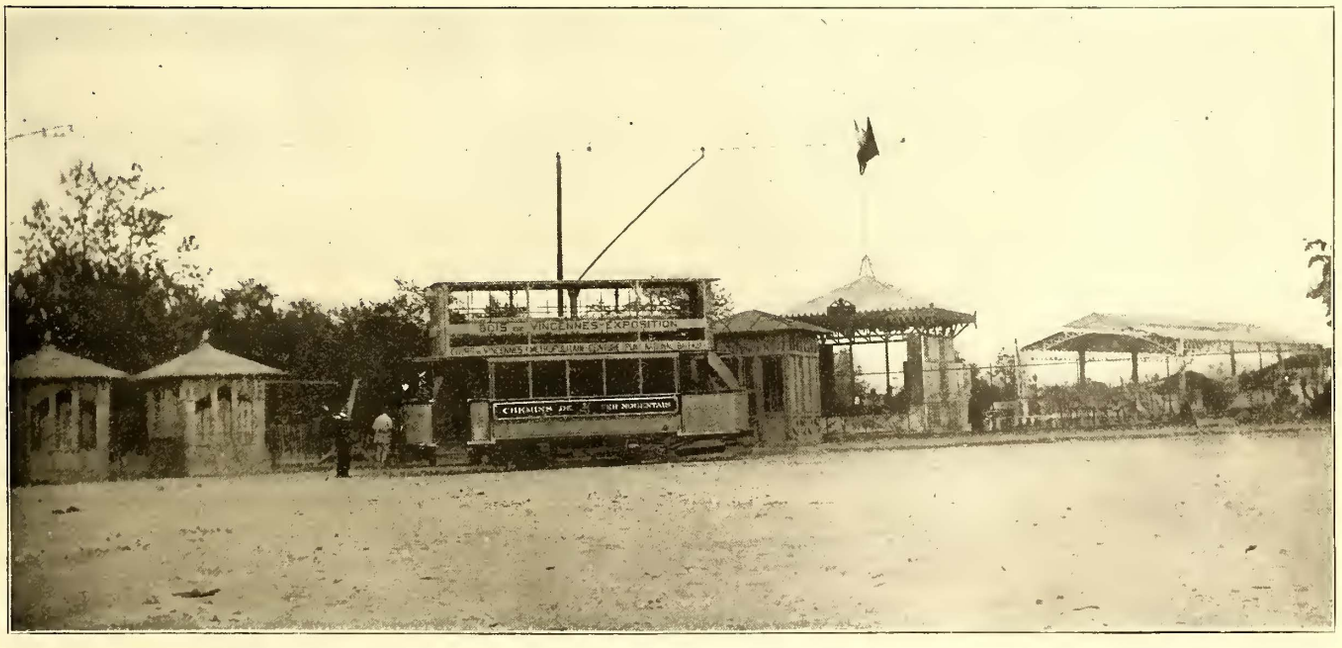


FIG. 1.—TERMINUS OF VINCENNES ROAD AT ENTRANCE TO TRANSPORTATION EXHIBIT

general tendency on the part of the public to spend their time at the main Exposition grounds, where side shows and other amusements abound. The transportation and machinery exhibits are exceedingly interesting from an engineering and educational point of view, and the question has been raised as to whether it would not have been more just to exhibitors and to the thousands of visitors interested in these matters to have allotted space for such exhibits within the Champ de Mars grounds, instead of devoting a large area to side shows and subordinating the true object of the Exposition to an apparent desire for pecuniary profit on the part of the administration.

FIG. 3.—INTERIOR OF ENGINE ROOM

The new electric line just inaugurated is intended as a connecting link between the Exposition annex and the various tramway lines which bring visitors to the city gates in the southeastern district, as, up to the present, there has been no street car service to the gate of Reuilly, where the main entrance to the Exposition of Vincennes is located. The cars are double-deck. It is intended to put twelve into service later on, but six only are used at the present time, as the line is less than 2½ miles long, and very few passengers are carried. On May 12, which was a Saturday, and, as above stated, the opening of the railroad to public use, the paying entries to the annex were only 759 for the entire day. Sunday brings out the crowds in every part of the city, and the paying visitors to Vincennes numbered on the 13th 6865, but it is doubtful whether there will be much passenger traffic on the new road on week days, at any rate until the season is further advanced.

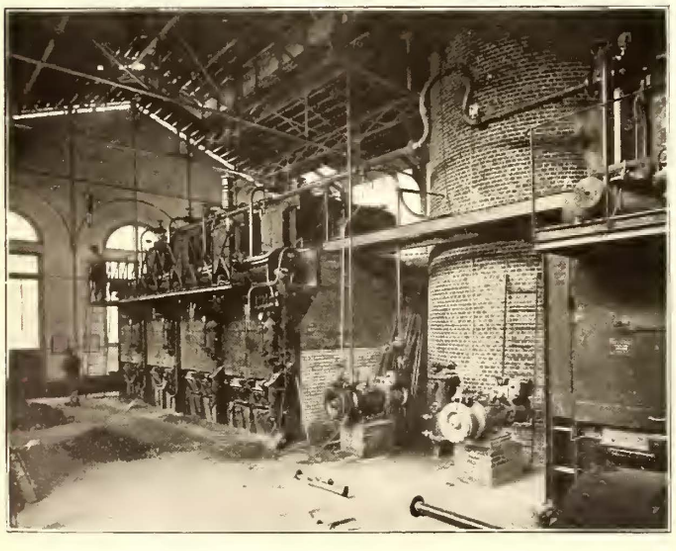


FIG. 4.—INTERIOR OF BOILER ROOM

The only point where the railroad passes outside the fortifications is at the gate of Reuilly, where a wide loop is made in front of the Exposition entrance. Fig. 1 shows one of the cars standing on the track at this curve, the entrance gateways being on the left and the Exposition buildings in the background. The roofed steel structure is the railroad depot where goods for exhibitors were unloaded; in the distance can be seen part of the Transportation Building, in which are the various types of locomotives built by French and foreign companies. Off to the right is the American Machinery Building. A double track is used on this loop, but the cars pass over both tracks in the same direction, the two lines being provided for the purpose of expediting the service at the gates, while two single tracks are laid in the cut-through fortifications.

A temporary car house has been erected near the upper end of the line, capable of affording sufficient shelter to the cars during the Exposition months. Near this building the track runs up a steep incline (Fig. 2), following the wagon road, and further on crosses the steam railroad of Vincennes, which has a station at the Place de la Bastille.

FIG. 5.—CAR NEAR CITY WALLS

The trolley wire is carried on side poles, with flexible brackets. A large extension of the railroad system is contemplated, and for this purpose a larger power station is being built than would be necessary for this temporary line. The station is located near the northern terminus, in Rue des Laitières, where there are installed two 500-hp single-cylinder engines by Weyher & Richemond, running at 90 r. p. m., and two 1000-hp cross-compound engines by Farcot, of St. Ouen, running at 92 r. p. m. The generators are built by the Postel-Vinay Company for the French Thomson-Houston Company. Those coupled to the single-cylinder engines give an e. m. f. of 550 volts, and these machines are used for the temporary railroad. The larger generators furnish current at 750 volts, and are intended to supply power for the distant points of the Nogentais system, but motor-generator sets are provided, for cases of emergency, to transform the current from the higher to the lower voltage, or vice versa, as may be required. The two smaller engines are already in running order, but their condensing apparatus is not yet in use, owing to lack of water. An artesian well is being sunk just outside the power house, but up to the present time the

heavy clay bed has not been pierced, although a depth of over 300 ft. has been reached. The condensers are located below the engine-room floor, on the ground level.

Both types of engines in this station are represented at the main Exposition in the Champ de Mars Machinery Building, where Weyher & Richemond have two engines of 1000 hp, and one of 500 hp, and Farcot one of about 850 hp. The former company makes use of a very peculiar valve gear, which has apparently not the quality of simplicity, although at first sight there seems to be but little complication. The steam pressure is about 114 lbs. per square inch in the valve chest of this engine, and for the Farcot cross-compound about 128 lbs. in the valve chest of the high-pressure cylinder.

The boiler room immediately adjoins the engine room, and contains two batteries of four boilers each. Belleville water-tube boilers are employed, with automatic feed-water supply and one feed-pump per battery, these being placed on special masonry foundations between the two sets of boilers, at the base of the smoke stack, which is carried through the roof. Economizers placed above the boilers heat the feed-water as it passes from the pump. Steam is kept at a pressure of about 240 lbs. per square inch, in the boilers, and is held in auxiliary reservoirs in order to provide for fluctuations in load. This high pressure effects a considerable saving in space, as a low pressure of steam would require larger boilers; beneath the engine-room floor reducing valves are provided for bringing the pressure down to the required amount.

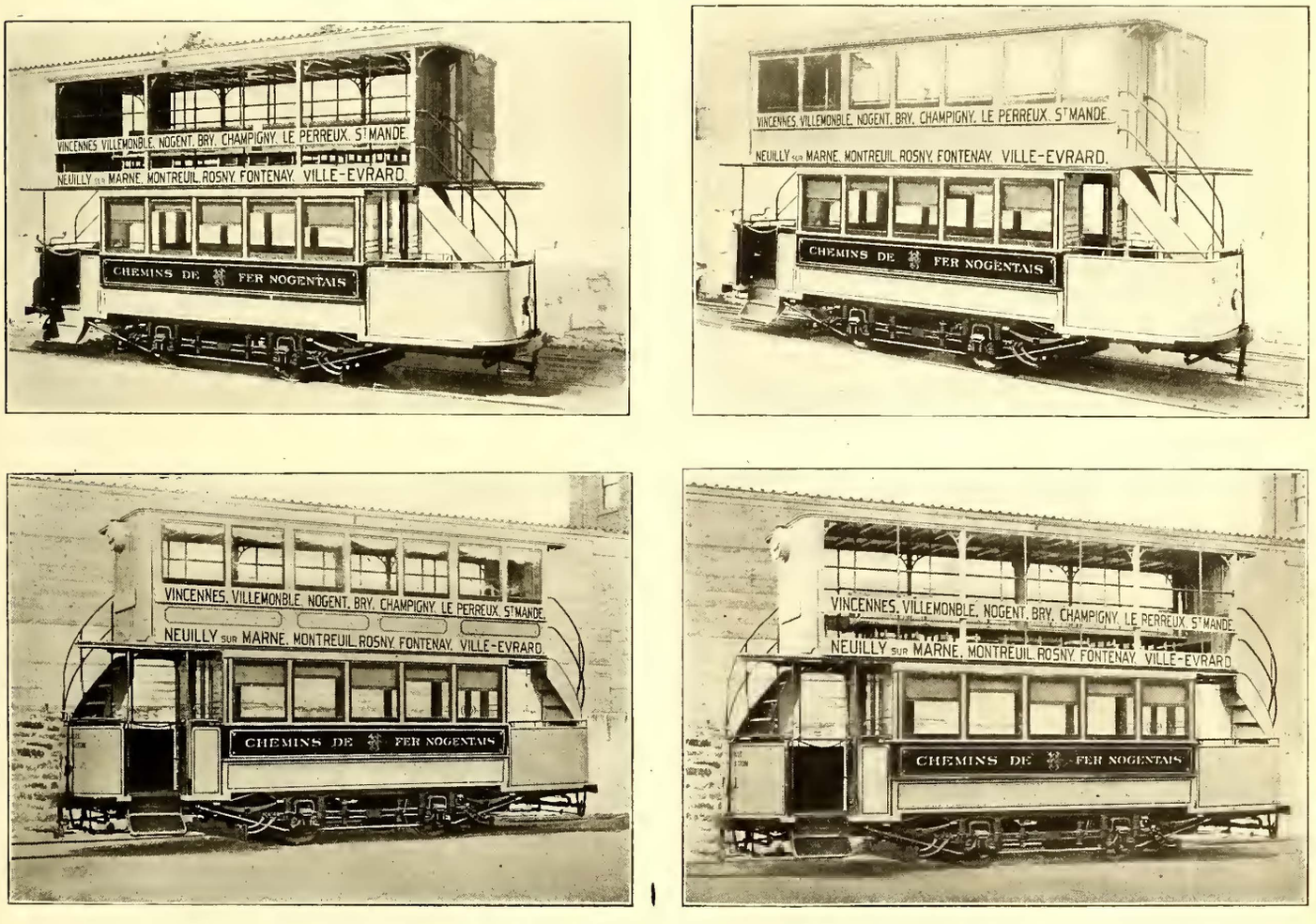
Behind the station are being erected two cooling towers, where the warm condensing water, falling in a shower from above and passing through a network of wooden rods, is cooled sufficiently to use over again.

The station is favorably located for furnishing power to the system it is intended to supply, being near the city limit and not too far from the center of the suburban lines. The switchboard, in addition to its four generator panels, will have thirteen feeder panels, supplying current to close upon 40 miles of track.

As the cars are of a somewhat novel type a few words of description will be of interest. Those used on the Vincennes line are of the double-decked type with bodies 14 ft. 11 ins. over all and inside 14 ft. 2½ ins. The platforms are a trifle more than 6 ft. in length, making the cars measure about 27 ft. over the dashers. They are mounted on No. 21-E Brill trucks with a 7-ft. wheel base and have two G. E. 58 motors. These cars were fitted so they would be able to draw a trailer.

In the lower compartment longitudinal spring seats covered with plush are used. The brass arms divide the seats into spaces, two of which have room for two sittings and the remaining one for three. In respect to the space allowed to each person the French regulations are extremely minute and particular. A small fraction of an inch below the required amount reduces the licensed number of passengers. On the lower deck 480 mm, or 18 29-32 ins. are allowed for each individual, the measurements going from center to center of seat arms. Upon the upper deck 460 mm or 18 3-32 ins., are allowed per person. Although the French are as a race smaller than Americans, the space required in their regulations is considerably greater than that considered necessary in America.

The sash of the lower deck drop and the windows are protected by spring roller curtains. The platform is unusually large and the opening is in consequence quite narrow. The dasher closes one side of the platform com-



FIGS. 6-9.—VIEWS OF CARS, SHOWING UPPER DECK OPEN AND CLOSED

pletely. The stairway is of the ordinary European type of sheet metal, but is made with a high rail so that accidents are not likely to occur. A projection of the upper deck forms a sort of hood over the motorman. The upper deck or imperial itself is a novelty in every way. As shown in Fig. 6, it will be seen that there is a substantial canopy supported on strong posts. These are reinforced by a light tubular railing. For summer work the imperial or upper deck is open as usual. It has longitudinal seats divided by bronze arms as in the space below. The seats themselves are of slats with open spindle backs. At each end is a bulkhead, part of which projects outward over the platform, and in this projection a space is found for a seat at each end accommodating two persons. The door, as will

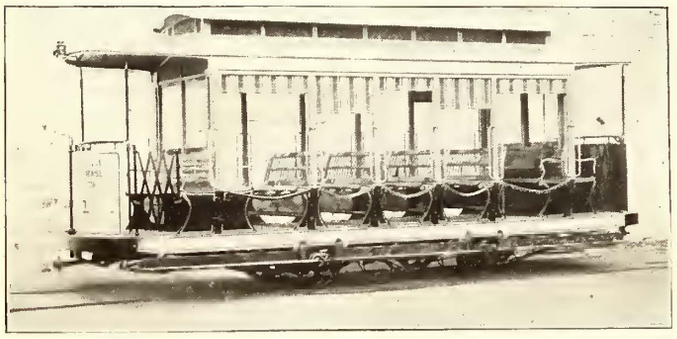


FIG. 10.—TRAIL CAR

be seen from Fig. 7, opens against the side of the car. This construction permits the seating of twenty-two persons on the upper deck, while but fourteen find seats below. The bulkhead is a valuable feature in the open car because it affords considerable protection in the case of wind or stormy weather.

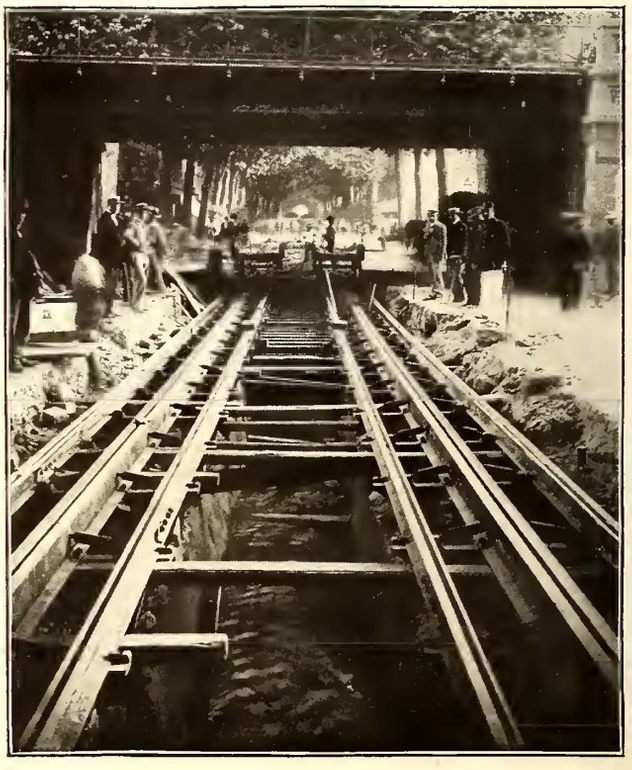
For winter service the whole imperial is enclosed by glass sash and panels as will be seen from Figs. 7 and 8. By the use of metal for panels the whole movable part is made very light so as to be easily handled, and is at the same time very strong. This form of construction, it is thought, has never previously been introduced. The metal for the panels is especially prepared and treated for this purpose. It makes the imperial quite as comfortable in winter weather as the other part of the car, and naturally increases its capacity. Beneath the seats on the upper deck a narrow monitor is introduced which increases the head room of the lower deck materially. One feature which will excite interest is the fact that the roof of the upper deck is made almost perfectly flat, and the trolley pole is carried by a light iron casting coming up from the main roof. This casting terminates in a bell, from which two gutters run to each end of the car. These gutters are seen in Fig. 6. In this the gutter can be seen in the center of the roof, the bell and the trolley tube being removed. In Fig 9 the tube is shown in place. Probably the practice is, when necessary, to pull the trolley pole down until it is flush with the roof. The long platforms are supported by angle-iron knees and the half elliptic springs on the ends of the trucks have a bearing not only on the body but on the platform. The truck with the motors weighs 9275 lbs., but the total weight of the car is only 18,825 lbs.

Apparently head room is at a premium, for these cars are scarcely high enough for an ordinary man. A six footer, even without his hat, has to stoop to pass into the imperial. The actual height in the clear is 5 ft. 6½ ins. On the lower deck it is 5 ft. 7¾ ins. The total height of the car from the rail is but 14 ft. 5¼ ins. With 33-in. wheels the platform is brought within 28 ins. of the head of the rail.

The trailers for these peculiar cars are not unlike those used in America on horse car lines, and are shown in Fig. 10. They are of the eight-bench open type mounted on Brill trail gear. The width in this case is so limited that it became necessary to introduce the peculiar form of grab handle shown. These are made in such a way that they do not extend outside the posts. The cars are 22 ft. 11 ins. long, have 4-ft. platforms and measure about 30 ft. over the dashers. Their width at the sills is but 5 ft. 7½ ins. and the seats are 5 ft. 11 ins. in the clear. The wheel base in this case, as in the other, is 7 ft. The seats are slat with open backs having ash spindles. The inside finish of the car is cherry with three-ply quartered oak head lining. The total weight of the car is only 7160 lbs. From the top of the sill to the step is but 13 ins., and the distance from the head of the rail is only a little greater.

Tramways of Nice and The Littoral

The towns along the Riviera from Cannes, France, to Menton, are being connected by an electric road. The entire system is being installed by the French Thomson-Houston Company, of Paris, which is directing all its energy toward completing the line at as early a date as possible. A 10,000-volt transmission line from Mescla, 30 km (18 miles) inland, supplemented by a steam plant



CONDUIT CONSTRUCTION AT NICE

at Nice will supply the power. When finished there will be 150 km (63 miles) of single track included in the street lines of Nice and the stretch of 50 km (31 miles) along the coast.

The former horse car system of Nice has been greatly extended and new lines have been added in and about the city. In the central portions, and especially on such streets as are traversed by the parades of the annual carnival, it has been thought desirable to build an underground conduit, but everywhere on the outskirts of the city the overhead trolley is used. The cars are adapted to travel over either system.

The construction of the conduit was delayed by last

winter's season, during which no work was allowed in certain sections, but it has since been pushed ahead night and day and, notwithstanding the numerous points where crossings of the lines occur with their accompanying elaborate special work, is almost entirely completed. The conduit is similar to the one built by the Thomson-Houston Company in Lyons and on the line from the Bastille to Charenton in Paris * and is well illustrated in the reproductions of the photographs taken during construction, which accompany this article.

Special attention has been given to the construction of the overhead line, the trolley wire running over the middle of the track as on American roads. The wire is 8.25 mm in diameter (No. 0 B. & S.) and supported either by means of transverse span wires or on long brackets from the poles. These latter are of the tubular type, but are so ornamented as to give quite a graceful appearance. In the city, wherever it has been possible, the use of poles has been dispensed with and the span wire has been attached to rosettes on the walls of the houses along the street.

The lines outside of Nice consist of the main line, which, starting from Cannes, traverses the cost to Menton, passing through Californie, Nice, Villefranche, Monte Carlo, etc., and by Cape Martin; and a branch line between Nice and the inland village of Contes. The latter is completely finished and will soon be in operation.

The Compagnie des Tramways de Nice et du Littoral, which is the operating company, has also secured the exclusive right to use the lines of railway recently built in Monte Carlo and described in the May issue. Menton, where the installation was last taken up, is expected to have cars in operation by the coming winter.

Double track is used entirely in Nice itself, but single track with turnouts is found at places along the coast. The gage is 1 meter. The rails are of the Broca or grooved girder type with a deep groove, and weigh 45 kg per meter (90 lbs. per yard). They are generally set on concrete and the joints are welded together by the Falk process. Granite blocks from the quarries of Saint Raphaël are used for paving.

The equipment of the power station at the Falls of Mescla consists of three 500-kw generators, each connected by a flexible coupling to turbines. The generators are twenty-pole, three-phase machines with stationary armatures and internal, revolving poles, having a frequency of 25 cycles per second and an electro-motive force of 10,000 volts.

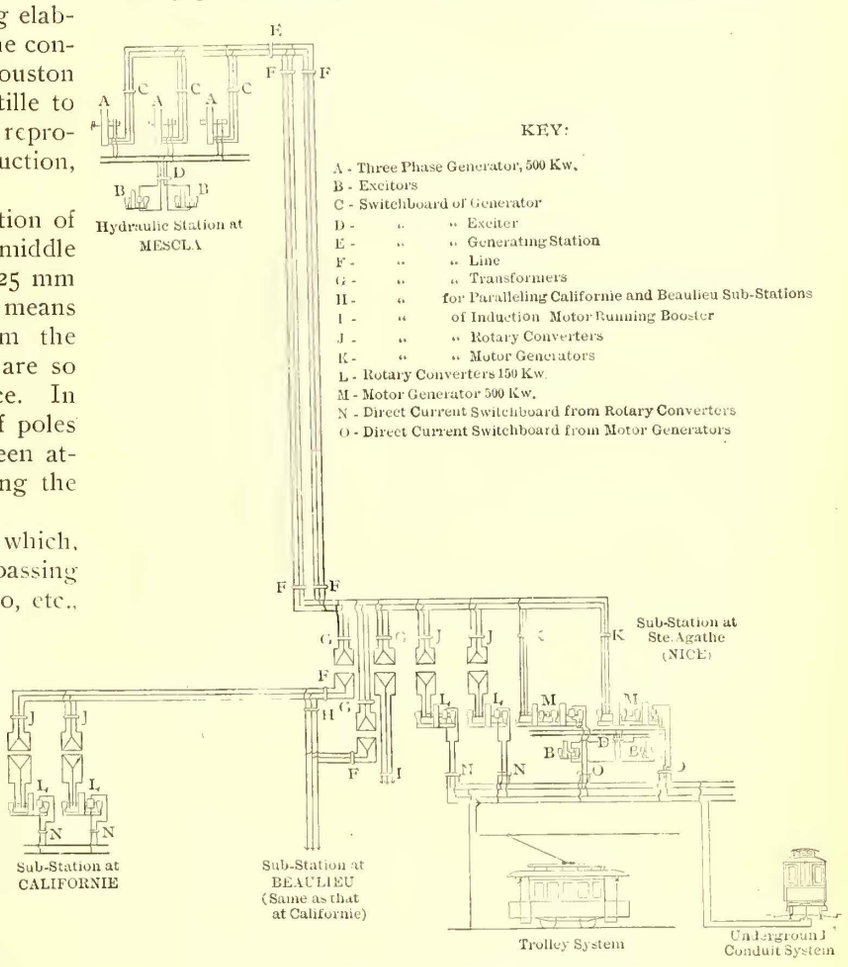
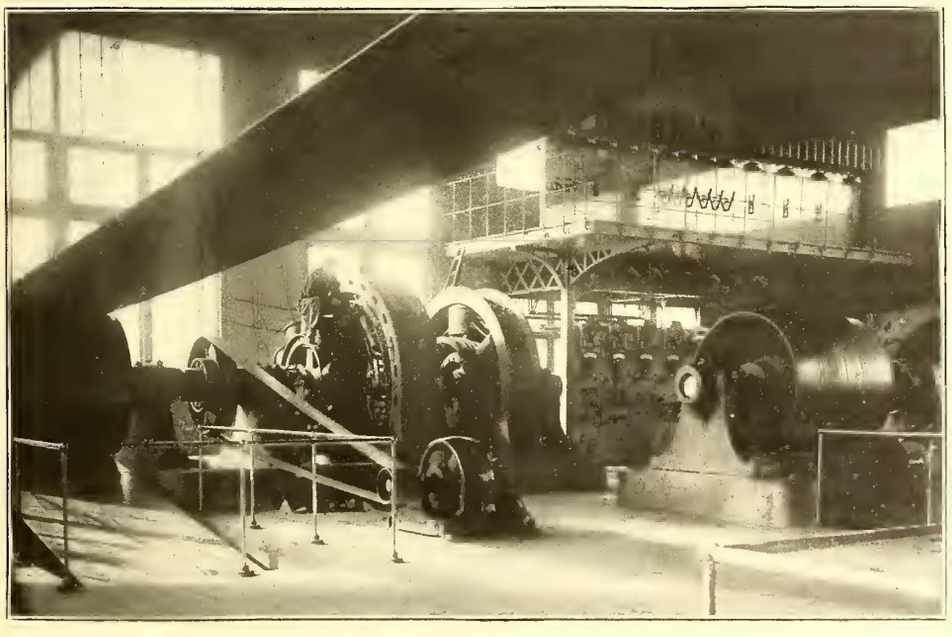


DIAGRAM SHOWING TRANSMISSION SYSTEM



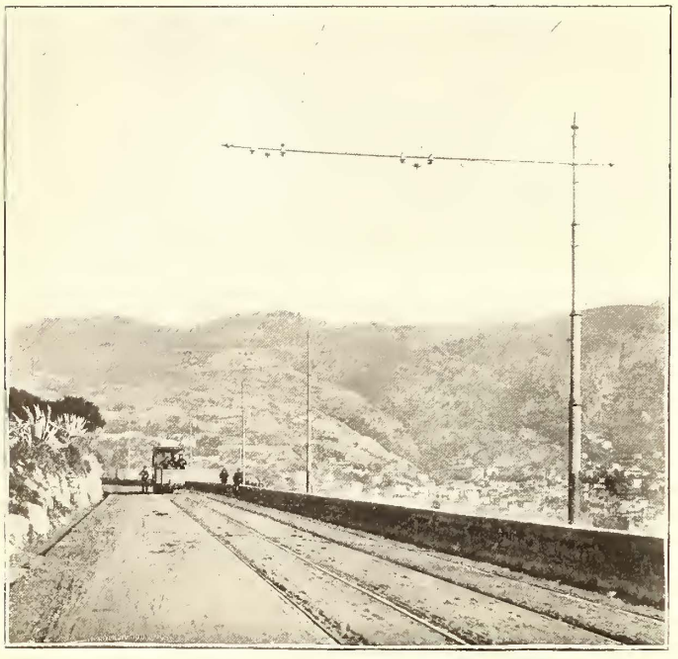
SUB-STATION AT NICE

On the 30-km transmission line connecting the Mescla station and the principal sub-station at Nice, there is a drop of 10 per cent. At Nice a portion of the current is transformed to 5000 volts, and retransmitted to two other sub-stations, one at Californie for supplying the line to Cannes and the other at Beaulieu for supplying the line to Monte Carlo.

As already mentioned, the sub-station at Nice contains the auxiliary steam plant. This includes two 700-hp double cylinder Corliss engines belted to the motor generators and two batteries of four boilers each. The latter are semi-tublar, having a heating surface of 185 sq. m (1991 sq. ft.) and a capacity of 20,000 kg (44,000 lbs.) of steam per hour. The diameter of the engine cylinders is 50 cm (19.68 ins.) and the stroke 1.21 m (47.64 ins.) They run at 100 r. p. m. There are two feed-pumps, one simple and the other compound, and a feed-water heater which uses the exhaust steam. The steam piping is mostly cov-

* See STREET RAILWAY JOURNAL, December, 1899.

ered with a non-conducting packing and the steam pressure is 10 kg per sq. cm (142 lbs. per sq. in.) There are two brick chimneys, one for each battery of boilers, 40 m (131 ft.) high and 2 m (6.56 ft.) internal diameter at the top.



POLE WITH LONG BRACKET

The illustration of the sub-station's interior shows the manner in which the engines are belted to the motor generators. These are two in number and consist of a 530-kw synchronous motor direct connected to a 500-kw compound railway generator. The synchronous motor receives the current directly from the Mescla transmission line at a pressure of 9000 volts. The generator has an e. m. f. of 500 volts at no load and 550 volts at full load. The speed is 300 r. p. m. The four-pole exciter for the motor, seen belted to the common shaft, is a 25-kw, 60-volt machine turning at 1100 r. p. m. There is one for each group of motor generators.

There are also in this station two rotary converters, for which the required e. m. f. of 340 volts on the alternating side is obtained by means of six static transformers. The three-phase transmission to Californie and Beaulieu at 5000 volts is supplied by six 55-kw transformers in two sets of three each. These lines may either be run entirely separate or thrown in parallel. Three 20-kw transformers reduce the pressure to 110 volts for running a small motor generator. This consists of a 50-hp induction motor, coupled directly to a 35-kw multipolar dynamo. The e. m. f. of the latter at 750 r. p. m. is 75 volts, and it is used as a booster on the line running to Contes. Oil insulation is used in the transformers.

The switchboard, part of which can be seen in the illustration, has altogether twenty-five panels. The principal ones are given in the diagram of circuits which accompanies this article, so that a detailed description is unnecessary. The arrangement of the instruments, etc., is according to standard practice. All connections are made by insulated cables on special porcelain insulators.

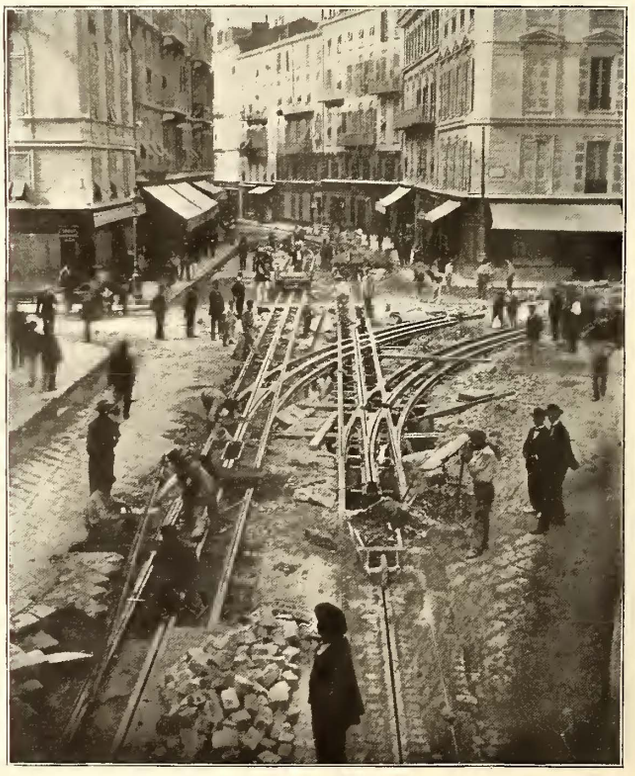
The machines are designed for a rise in temperature of 45 degs. C. (113 degs. F.), but will stand an overload of 25 per cent for half an hour, and one of 40 per cent for a few minutes without overheating or mechanical strain.

The station is lighted by direct current enclosed arc lamps on a 120-volt circuit. The current is obtained by using a 20-kw motor generator to reduce the pressure from 550 volts. This machine has a speed of 875 r. p. m. and is composed of a 550-volt motor direct coupled to a compound-wound dynamo.

The sub-station at Californie and Beaulieu, whose equipments are identical in all respects, are connected with the main sub-station at Nice by lead covered cables running in an underground conduit. These cables contain three wires, each 30 mm² in cross section (between Nos. 2 and 3, B. & S.) which transmit the three-phase, 5000-volt current from Nice. The sub-station at Californie is completely installed. The equipment consists of two 150-kw rotary converters and six 55-kw static transformers for reducing the pressure of the transmission line from 4300 to 340 volts. The rotaries have a speed of 750 r. p. m. and are 10 per cent over compounded. The switchboard has five panels, four of which are shown in the diagram. The one omitted is the line panel.

The feeders are nearly all underground. About the only exceptions are along the Contes line and for a short distance from the sub-station at Beaulieu—perhaps 10 km altogether. These overhead feeders are carried on the same poles as the trolley wire. They are 125 mm² (.194 sq. in.) in cross section. The underground system is made of armored cable 200 mm² to 400 mm² (.31 to .62 sq. in.) in cross section, which is carried from the sub-station to the points of distribution by the shortest possible paths. In order that the municipal regulations regarding difference of potential between the track and underground pipes may be strictly adhered to, a complete system of voltmeter or "pilot" wires has been designed and connects all the important parts of the line with the station switchboard. All danger from electrolysis is thus practically avoided.

When completed one hundred motor cars will be operated on the road, and if the service demands it, as many trailers as necessary. Twenty-two express or freight cars



LAYING A PART OF THE CONDUIT SECTION

and three electric locomotives will also be used. The motor cars are made in three models; those with but one compartment, those with two, for first and second class, to be used on the interurban line, and special parlor cars.

The electrical equipment of the cars consists of two G. E.-58 motors and electric brakes, controlled by B.-24 controllers placed at each end of the car. The cars are furnished with both trolley arms and underground contact plows so that they may be run at will over any part of the entire system.

CORRESPONDENCE

The Need of Heavier Wheels

BUFFALO, June 18, 1900.

EDITORS STREET RAILWAY JOURNAL:

We wish to call attention through the columns of your paper to a matter of importance in the service of wheels on electric street railways.

Owing to the increase in traffic, a number of roads in the larger cities have been rebuilding their equipment, using parts of the old equipment in the new construction. In the case of wheels and axles the lighter sections used under the cars and equipment are inadequate for the service demands of the new construction, even when eight wheels are used under one car, instead of four, as formerly, the new cars being, as a rule, longer than the old ones, and the use of eight wheels being necessary on account of the introduction of double trucks.

The additional strain imposed has been recognized in the case of axles by the substitution of axles 4 ins. and over in diameter, where formerly $3\frac{3}{4}$ ins. was the largest size used, but the weight and section of the wheels have not been correspondingly increased, and in fact have been practically decreased by the extra strain imposed in pressing them on the larger axles, which, of course, necessitates boring them out larger, and hence leaving less metal in the hub to resist a greater strain.

We are recommending a weight of not less than 400 lbs. for wheels 33 ins. in diameter, used under equipment where 4-in. axles and over in diameter are used. This allows for an increase of 25 per cent in the section of spokes and web, as compared with the 33-in. 360-lb. wheel that has been the standard for the past five or six years, but this increase of 25 per cent in the section only adds 10 per cent to the weight of the wheel, and as the railway company obtains increased scrap value from the additional metal the cost of the wheel is not materially increased.

It may be argued by managers of electric railways that the present section seems to be sufficient for the needs of service, and that a change might be considered when it proved insufficient, but this seems hardly a wise view to take if accidents are to be avoided. The conditions of service which may not cause accidents under ordinary temperatures are most likely to do so under continued low temperatures, and it is necessary to provide for maximum conditions, no matter how seldom they may occur.

There can be no doubt that the factor of safety has been decreased by the increase in the weight of equipment and speed at which electric cars are operated.

We are prompted to write you on these points in view of what appears to us as the great need of keeping the quality and character of the wheels for electric service up to the increasing demands of this service.

We believe that the officials of electric railways are in favor of such progress, but it is a question whether in the press of other matters they are always able to give the necessary time to this particular subject, and to appreciate the importance of it.

NEW YORK CAR WHEEL WORKS,
Pemberton Smith, Engineer.

Polyphase Transmission for Electric Railways

PITTSBURGH, Pa., June 18, 1900.

EDITORS STREET RAILWAY JOURNAL:

The following electric railways should be added to the list contained in your issue for June 2, as using polyphase apparatus for power transmission:

Name of company	Power transmitted
Long Island Railroad Company (Far Rockaway branch)	267 hp
*Sanford & Cape Porpoise Railway Company, Sanford, Me.	667 hp
Utah Power Company, Salt Lake City, Utah	2000 hp
Youngstown Park & Falls Street Railway Company, Youngstown, Ohio	533 hp

*Uses a 500-kw double-current generator.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.

Electric Heaters

NEW YORK, June 12, 1900.

EDITORS STREET RAILWAY JOURNAL:

We have noted in your June number an editorial on the subject of electric heaters for street cars. We must take exception to some of the statements made, as we have placed upon the market during the past five years nearly 50,000 electric heaters, but up to the present time we have never heard of one single instance where a Gold electric heater has burned or even scorched a dress; neither is there a record of any one of these heaters ever having short circuited or given trouble in any way.

In the Gold electric heater the circulation of air through the resistance coils is so rapid that the flow of warm air from the top of the heater, while large in volume, is moderate in temperature, and is never so intense as to unduly heat the front casing. In regard to short circuiting, one look at the construction of the Gold electric heater will thoroughly convince any one that it is absolutely impossible for a short circuit to take place within the heater, for the reason that the resistance coils are supported in such a way that should any accident occur, it would be impossible for them to leave their supports.

The place for an electric heater in a street car is just where the great majority have been applied, that is under the seats and set back into the panel board. A heating system like the one suggested in your article, intended to carry the warm air up back of the seats and heat the windows and incidentally the necks of the passengers, leaving their feet cold and the floor of the car wet, would be entirely impracticable. The consumption of current in electric heaters has been reduced to such a point that railway managers on all of the large systems throughout the country appear to be entirely satisfied on this point.

We might add that in a test recently made with our Gold improved electric heater an overload of 25 per cent was put through the heater, and the casing was entirely covered with damp cloths. The current was left on then one full hour, and at the end of that time there was not the slightest indication of burning or discoloring in any way.

No heater in actual practice is ever put to such a severe test as the one mentioned. It simply shows that when our heaters are used, no fear need ever be entertained of burning the clothing of the passengers or of the heater coils short circuiting.

GOLD STREET CAR HEATING COMPANY,
By Edward E. Gold, President.

STREET RAILWAY JOURNAL

JULY 7, 1900.

PUBLISHED WEEKLY BY
THE STREET RAILWAY PUBLISHING COMPANY
MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.
Chicago Office: Monadnock Block.
Philadelphia Office: 929 Chestnut Street.
London Office: Hastings House, Norfolk St., Strand.

Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York."

Entered as second-class matter at the New York Post Office.

TERMS OF SUBSCRIPTION.

In the United States and Canada ..... $4 00 per annum
In all Foreign Countries, per annum ..... { $6.00 / 25/ / 31fr.

Subscriptions payable always in advance by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

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

The Street Railway Publishing Co.,
Beard Building, 120 Liberty Street, New York.

The equipment of towns and cities with the trolley system of tramways in England is certainly eliciting a great deal of attention from the residents. An interesting letter regarding the color of the poles from a writer signing himself "Artist" has recently been published in a paper of a town whose roads have lately been electrically equipped. This artist calls attention to the color of the poles, and advocates a grey-blue color as being particularly suitable for the purpose on account of its being what he calls a "retiring" color. At the same time he also advocates painting the cross arms blue, as they are often seen against the sky, and will be less noticeable if painted this color. He also points out that in many of the streets in his town the houses are of red brick, and that perhaps in that part of the city the poles might be painted a similar color. It is curious to note the interest which these details have elicited, though we are of opinion that the various colors which this artist suggests, instead of making the poles less conspicuous, would have the very opposite effect, and we think that this may be safely left to the engineers in charge of the work, who undoubtedly are familiar with the proper colors to give poles from their experience in other towns.

It appears that Russia is to be invaded by American manufacturing capital, which will shortly establish large plants for the production of electrical apparatus, pumps, sewing machines and other American machinery of all kinds. The value of American special machines in reducing the cost of manufactured product is coming to be generally recognized in European countries, as can hardly fail to be the case, considering the enormous difference in costs brought about by their use.

We chronicle elsewhere the establishment by the employees of the Camden & Suburban Railway Company of what has been called a "Discussion Night," to be held once a month. The plan has the cordial co-operation of the officers of the railway company, who have presented a room to the employees for holding their meetings. This plan, which we think has been, and is, in operation on a few other roads in the country, of meeting once a month and discussing problems in electric railroading, is a most desirable one. The association not only proposes to discuss electrical and mechanical problems, thus making the operation of electrical apparatus much simpler to the user, but also to take up the operating problems upon which there is much less literature or opportunity to study from text-books than in electrical apparatus.

The general practice in steam engineering in this country is to depend entirely on the cut-off, as controlled by the governor, to vary the admission of steam in the cylinder with changes in the load. In this respect American practice differs from that in England, and in some other foreign countries. There, throttling for low loads is extensively practised. That is, the cut-offs of the engine are controlled in the usual way, but where the engine is running considerably under load the throttle is partly closed by the man in charge. It may be news to some of our readers to learn that this practice, especially with compound engines, has given a very high efficiency, as compared with engines operating under full steam pressure with all loads. There are several reasons for this. In the first place, with a fluctuating load such as in street railway service, it is exceedingly difficult, with full steam pressure, to maintain an equality in load between the high and low pressure cylinders at low loads, consequently the low pressure cylinder becomes a drag on the engine. Again, where throttling is practised, the steam after passing the throttle, is in a certain sense superheated. That is, while its temperature may not be higher than that before it passes the throttle, there are more heat units in the steam than are required for saturated steam at the lower pressure at which it is admitted to the cylinder. This fact adds to the economy of the engine in producing less cylinder condensation, which is a considerable loss in all engines. Again, the differences in terminal temperatures in the high-pressure cylinder at low loads will be less, in which case we should expect to obtain better steam consumption results. These arguments, at any rate, are those used by the advocates of throttling. While the advantages may seem somewhat hypothetical, it is interesting to note that the method is being tried in this country. In one station, for instance, the equipment consists of a number of 300-hp high-speed engines, each belted to a generator, and one 1250-hp direct-connected compound Corliss engine. Ow-

ing to its lower economies at low loads, the all-day efficiency of the 1250-hp engine has been found to be 10 per cent less than that of the 300-hp engines, which, owing to their small size, can be thrown in and out of service as required, so that those running can be worked up to their full rating continuously. The owners of this station are going to try throttling the large engine at low loads, and hope to obtain better results.

The decision by the managements of the Boston Elevated Railway Company and the Manhattan Elevated Railroad Company, of New York, to adopt the multiple unit and double unit systems, respectively, for the operation of trains on their elevated roads, probably sounds the knell of the "locomotive" for high-speed city and suburban transportation, both in this country and abroad, and it is safe to say, we believe, that nothing but distributed motor systems will hereafter be considered, unless by ultra conservative or poorly informed engineers and capitalists. The chain of logical sequence in arriving at "distributed motor" systems as the only solution to the rapid transit problem is as follows:

1. The conditions are that immense numbers of passengers must be moved at the highest possible speed, on trains which follow each other as closely as is consistent with safety, over lines where stations are close together.

2. To produce high speed under these conditions, rapid acceleration is a necessity.

3. The rate of acceleration is limited by the "traction" of the driving wheels. This "traction" can be increased by increasing the weight on a small number of drivers, or by increasing the number of drivers.

4. The limits of possibilities on the first, or locomotive, plan are soon reached—by the second, or distributed motor plan, the limits are far ahead of the necessities, since 100 per cent of the train weight can be placed upon the drivers if desired.

5. With modern rapid transit, the locomotive system is and will be a failure. The distributed motor system, on the contrary, can, and will, revolutionize city traffic.

6. Incidental savings and advantages of great aggregate value are also found in the improved system—such as economy in switching, ease in maintaining schedules, simplicity in running branch line service without transfers, and economy in current consumption.

During the past two years the opinions of engineers have been completely reversed, and those who laughed at the idea of there being any economy or advantage in the distributed motor systems are now their most ardent advocates.

The world is now witnessing in Paris the complete paralysis of a city transportation system twenty years behind the times, and which, under the strain of a temporary increase in traffic due to the Exposition, has wholly broken down. This result is due less to lack of enterprise on the part of private capital than to absurd "regulation" and obstacle making by the French national, and the Parisian local governments. These have made determined and hitherto successful, opposition to the one great improvement—electric traction—which would make it possible to carry ten passengers in Paris where one is now accommodated. Does this seem an exaggeration? We have only to point to the history of transportation in New York City during the past twenty years to see how tremendous has been the increase in carrying capacity which electricity has brought. We could forgive Paris, however, for her "conservatism" in not permitting electric railways to invade her streets, particularly as the outside world shares in the beauty of Paris as it is, without suffering greatly, except for a few days or weeks in the year, from the inconveniences which Parisians themselves are forced to stand permanently; but it is more difficult to overlook the absurdity of the "*complet*" system which paternalism forces upon its sons and daughters in the mistaken idea that they are benefited thereby. As this "*complet*" system is occasionally held up in American city councils to the admiration of the people in an effort to further "no seat, no fare" ordinances, a few words as to how it works, both now and under ordinary circumstances, may not be out of place.

Imagine an omnibus or street railway route passing from the heart of Paris to a suburb, and lined with little waiting stations 500 to 1000 ft. apart. A bus takes its load at the city terminus, the passengers filling all its seats but five, let us say. Merrily it starts off on its journey, and in due course of time reaches the first waiting station. There it finds ten passengers anxious to embark. Each of the ten on entering the station has received a numbered ticket, and the five only who entered first out of the ten are permitted to take the bus. The load is then "*complet*," and a white card bearing that word is hung on the outside. If at the next station no one wishes to get out, the bus rolls on, leaving fifteen or twenty disappointed people in its wake, hoping that they may be more fortunate with the next arrival.

Now, in ordinary seasons, when no extra crowds are in Paris, a way passenger need not ordinarily wait more than from ten to twenty minutes on the less popular routes for the privilege of boarding a bus or car, and perhaps during the lighter traffic hours of the day not even so much. Now, however, it is a matter of hours, rather than of minutes, even to secure a seat at the city terminus of the suburban lines, while it is utterly impossible at almost any time to get on board at the way stations other than at transfer points. In a single case recently a trip to the Transportation Building at Vincennes, and return, required seven hours of waiting and riding together.

What wonder is it, then, that all Paris, native as well as foreign, has risen in arms against the transportation system, has mobbed the buses, the waiting rooms and the company's offices, has refused to submit to antiquated regulations, and is insisting upon better facilities. No such system would be tolerated in America for a moment, and if the experiment should sometime, by some mischance, be tried in an American municipality, the people would rise in their majesty after a day's experience of it, and would demand as a valuable privilege the right to again hang on to the much-abused strap, refusing utterly to wait even five minutes for a car which is not "*complet*."

The Starting of Rotary Converters

The increasing use of alternating-current transmission and rotary converters for the delivery of current to street railway lines warrants a discussion of the special problems of such work in these columns. The rotary converter,

while a most satisfactory machine when operating at full speed, is, so far as its alternating-current supply is concerned, a synchronous motor, and is consequently subject to the difficulties of starting inherent in this type of machine. Wherever possible, it is best to start rotary converters as direct-current shunt motors. This, of course, necessitates some source of direct current other than the rotary itself, since the latter will not transform alternating into direct current until it has reached full speed. With a storage battery such a source is always available, and with two or more converters in one sub-station any one can be started by means of direct current after any other is in operation. With continuous 550-volt copper from one station to another, the rotaries in a sub-station can be started up by direct current, transmitted from another sub-station or from the central power station over the trolley wires and feeders, the current drawn to start a machine at the sub-station not being sufficiently large to cause an excessive drop between stations if there are no cars on the line trying to start up at the same time. When starting up in the morning, if direct current is available at one station, this is a very satisfactory method, but if a shutdown occurs during the day this method of starting is likely to be interfered with by cars attempting to start up at the same time and pulling down the voltage at the unstarted sub-station to such an extent that the rotaries cannot be brought up to speed.

For starting by means of direct current there is required a starting rheostat in the circuit from the armature to the direct-current bus-bars, just as though the machine were a direct-current shunt-wound motor. Generally this starting rheostat is shunted around the negative main switch. In this case the negative terminal of the field of the machine should be connected to the negative bus-bar and not to the negative brush of the machine, so that the field may get full voltage before current is admitted to the armature. By closing the positive switch, the circuit breaker and the field switch, the field becomes excited, and by closing the path through the starting rheostat and cutting out resistance the armature is brought up to speed just as is any direct-current motor, after which the negative main switch can be closed, short-circuiting the starting box, and the machine can be synchronized and switched into the alternating-current circuits in the usual way.

Another satisfactory way of starting rotary converters is to switch them all into circuit before the main generator is started, and to excite the field of the latter to full strength before starting it, in which case the rotary converters will all speed up in synchronism with the main engine and generator. This requires that the exciter be separately-driven independently of the main generator. This method is applicable to starting up in the morning, but is, of course, not applicable to throwing on additional rotaries while the plant is running. In cases where there is a rotary converter in the central generating station this one rotary can be started up in the morning in this way, the others in outlying sub-stations being started by means of direct current from the central rotary transmitted over the trolley wires.

If it is necessary to start rotary converters with the generating plant running at full speed and with no direct current available, the above methods cannot be used and some means must be provided to start them by means of alternating currents at full frequency. In general, two methods are used. In one of these, a small starting motor of the alternating current induction type, which starts up readily from a standstill, is coupled to the shaft of each rotary converter. These starting motors bring the rotaries up to speed just as would any external source of power, the rotaries building up their own fields from residual magnetism, just as do any mechanical-driven direct-current generators. The rotaries are then synchronized and switched in to both the alternating and direct circuits in the usual way. Another method is to start the rotaries by switching the alternating currents into the armature through the usual collector rings, the fields of the rotaries being unexcited. A considerable rush of current follows, generally much more than full-load current, setting up induction-motor action on the field poles, which gives sufficient torque to overcome the friction of the machine and bring it up to speed. If alternating currents at full voltage are thrown on in this way, the rush of current is so great as to seriously pull down the voltage, unless the rotary is small as compared with the generator and line carrying capacity. For this reason transformers designed to give an extra low voltage for this purpose and termed "compensators" are usually put in.

The alternating currents in the armatures of the rotaries, when these are at standstill or are running at low speeds, set up alternating magnetism in the field magnets, inducing very high alternating e. m. f's. in the shunt-field magnet windings. The many turns of the shunt winding of a 550-volt rotary will receive such a high e. m. f. in this way that it is customary to use what is called a "break-up" switch to separate the several coils of the shunt-field winding from each other so that the voltages set up in all of the coils will not be added to each other to strain the insulation at the ends of the winding and cause a breakdown of the insulation and ground on the frame. The alternating magnetism in the field also sets up an e. m. f. in the series field coil, which tends to send a powerful current through the shunt round the series coil. To prevent this a switch is inserted in this shunt so that it may be opened at the time of starting.

This method of starting is perfectly satisfactory as long as the transmission line is supplying no other load calling for steady voltage. If the rotary converter to be started is a small one and the capacity of the line and generators is comparatively great, it works all right; but, otherwise, it overloads the line, and any other load upon it gets a bad drop of voltage. For this reason when there are two or more rotaries in a sub-station they should be fitted with direct-current starting boxes. With this means one may be started in the morning by means of alternating currents at a time when there is no load to be disturbed; the other or others may then be started by direct current without trouble from overload. If there are two or more sub-stations taking power from one generating station and the attempt is made to start up in the morning by means of alternating current applied to the rotaries at full frequency, one sub-station may be synchronizing and another will throw in and draw such an overload as to pull down the speed of the generator and prevent the first sub-station from getting in synchronism. A far better way is to either start all the rotaries with the generator or to start one rotary converter at one station by this means or even by the use of alternating current at full frequency, and from this rotary converter transmit direct current to the other sub-stations for starting purposes.

Transportation Building at the Bois de Vincennes

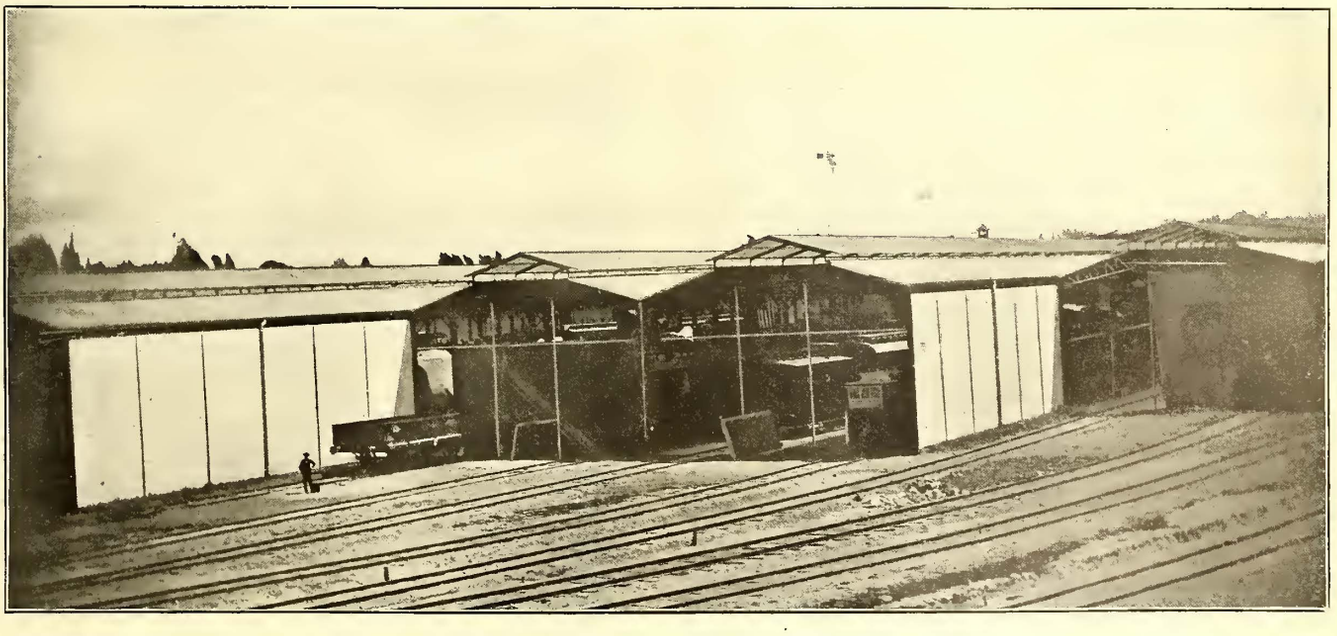
[*From Our Regular Correspondent.*]

Allusion has been made in another article to the startling contrast between the superb Palace of Transportation on the Champ de Mars, and the Transportation Building at the Bois de Vincennes section of the Paris Exposition. In more than one respect the contrast illustrates the promise and the performance, the plan and the realization, of this really great and beautiful World's Fair. The limited space on the Champ de Mars and the Trocadero Hill was given out so lavishly to meretricious, salacious sideshows that there was no room left for the main Exposition or for objects of real value and merit. The money available for a Transportation Building was expended so generously on the one in which very few appropriate exhibits can be found that when it came to provide for the overflow, nothing more could be done than to erect the meagre, cheap sheds which are here shown, and which, as a general thing, can be reached only after the expenditure of considerable time, money and patience. Yet even this division, exasperating as it is, does not quite represent the confusion and muddle, for street railway apparatus is to be found—when found—in no fewer than five different parts of the show, and there are not less than six distinct, different sections in which transportation exhibits, generically considered, have been placed. There may be more, when all the exhibits have finally got into place. If this is borne in mind, with the additional fact that, up to the middle of June, two months after the Exposition opened, no transportation catalogues or lists were obtainable, it will be seen that the mission of the man bent on studying the subject for himself or others is not yet an altogether grateful one.

The Transportation Building at Vincennes is just across a small lawn from the American Machinery Hall, and is best reached by taking the steamboat down the river and the Thomson-Houston street car line up the hill to the main entrance gate, where the line circles. As will be observed,

FRONT OF TRANSPORTATION BUILDING, VINCENNES

the building is in reality a series of low train sheds. Along the white front the names of the different countries are painted, for guidance, and within are a large number of tracks connecting with the steam railroad network of France, so that cars, locomotives and rolling stock of standard gage have been able to come right in and be switched and shunted into position. For pieces not of standard gage special sections of track have been set up. Between the tracks extend long stretches of plank platform up and down which visitors move in inspecting the exhibits. As a general thing, heavy rolling stock has been placed at the inner end of each track and the street cars at the outer or receiving end. Outside the building are other receiving tracks for freight cars, etc. The United States has inside the building about 22,000 square feet, of which 16,000 square feet is net, and and a little over 400 feet of the exterior track.

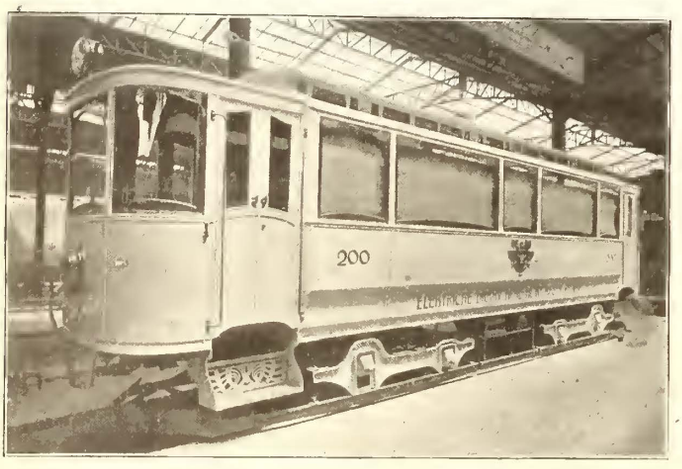


TRACK ENTRANCE TO TRANSPORTATION BUILDING, VINCENNES

Outside the group of electric locomotives, most of which

are now in position and have had their wrappings taken off, the most interesting and ambitious exhibit is probably that which is intended to illustrate the Budapest underground road. Not only is one of the regular cars shown, but there is a complete cross-section of the road itself, and one of the neat and pretty stations, with the white tiling,

TEMESVAR VASUT TROLLEY CAR

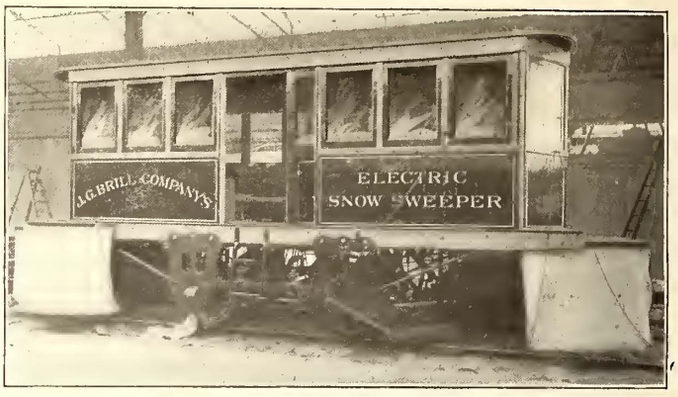


AUSTRO-HUNGARIAN TROLLEY CAR

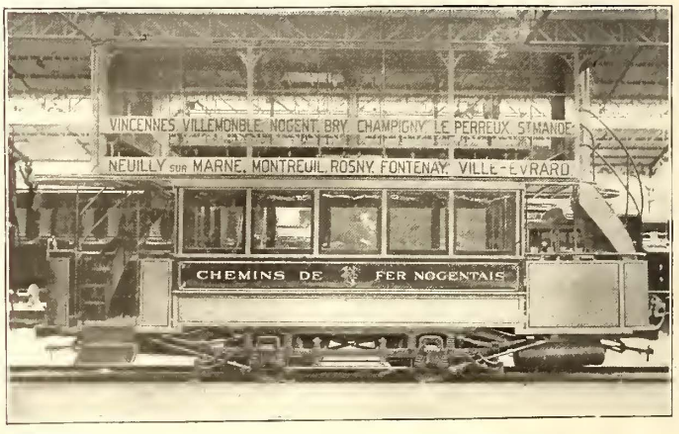
STEAM LOCOMOTIVE, LYONS-NEUVILLE

stairway, steel columns, platform, etc. The car is also complete in every respect, and carries its bent-bow trolley, while the overhead and track wiring and bonding are also illustrated in detail. If one were to visit Budapest, it would not be possible to see much more. Incidentally, it may be mentioned that elsewhere in the building Austria-Hungary has also two other neat exhibits in the shape of one of the regular street cars in use at Temesvar, showing a very solid vestibule at each end for the motorman; and a fine Prague trolley car.

The French exhibit of street cars and tramway locomotives is quite extensive, but without a very close examina-



BRILL SNOW SWEEPER

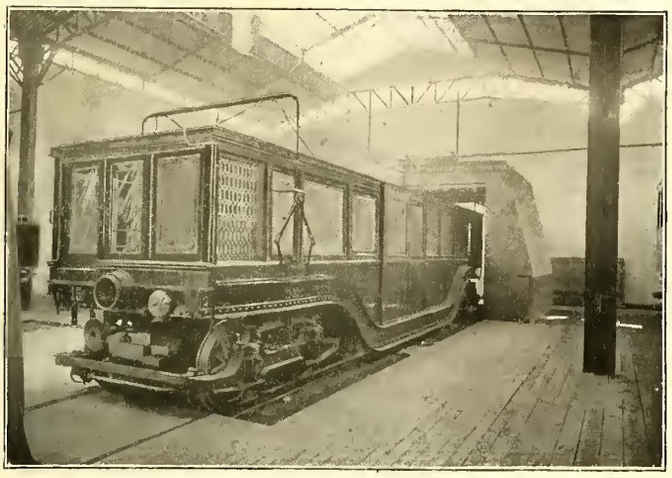


CAR CHEMINS DE FER NOGENTAIS

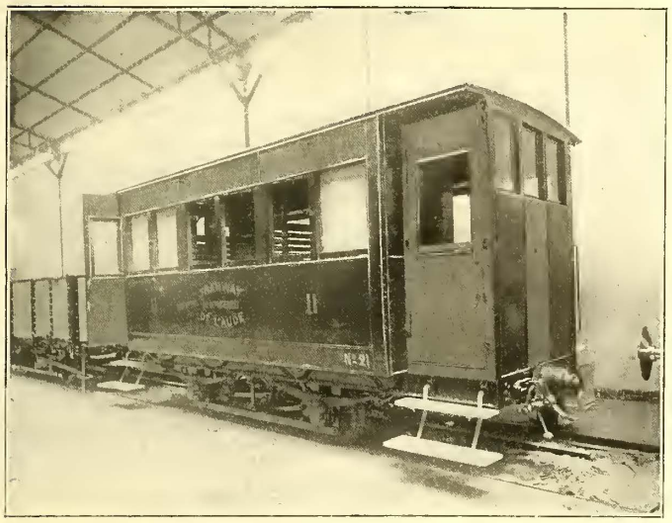
EXACT REPRODUCTION OF BUDAPEST UNDERGROUND ROAD AND STATION

tion it is rather hard to say where the distinctive French part in the exhibit begins and the American part ends. American trucks and cars of such types as the Brill and Peckham are freely used in Europe, and not less freely plagiarized; and on all the newer work the imprint of American ideals and practice is to be detected, in virtually every branch of design and operation. There are, how-

ever, many vehicles unfamiliar to the American visitor, such, for example, as the steam locomotive from Lyons, or the narrow gage, rack rail electric locomotive from the



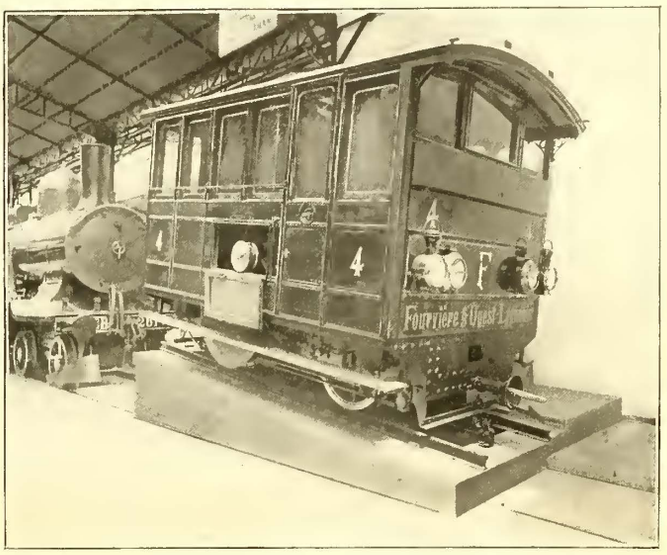
BUDAPEST UNDERGROUND CAR AND ROAD



CAR OF TRAMWAY DEPARTMENT DE L'AUDE

BASTILE-PORT RAPP, DOUBLE-DECKER

Fourviere & Ouest-Lyonnais for very stiff hill climbing. The tramway car of the Department de l'Aude, for second class, is also interesting, if only because of the wonder it engenders at the courage exhibited in trying to operate a tramway line on a steam road basis, with a complicated tariff and all its necessary attendance and bookkeeping. The French exhibit includes also a number of double-deck



ELECTRIC LOCOMOTIVE FOR HILL CLIMBING, FOURVIERE OUEST LYONNAIS

cars of different types, for steam, electricity or compressed air; but these only supplement several shown at the Champ de Mars, as illustrated in the June JOURNAL, or as treated in detail in a separate article on the Vincennes special trolley road.

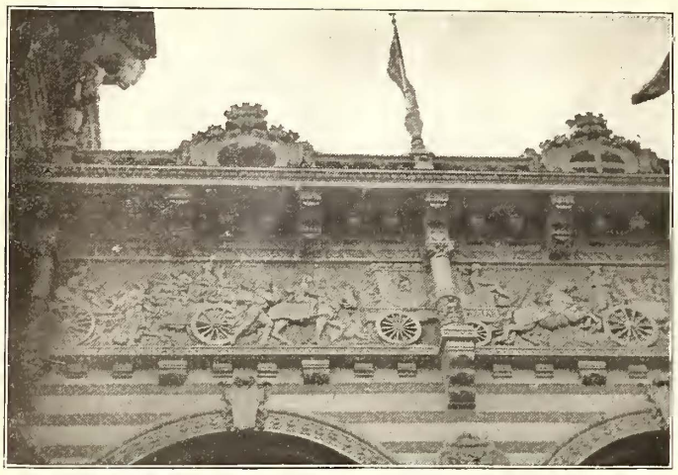
Decorative Panels, Transportation Building, Champ de Mars

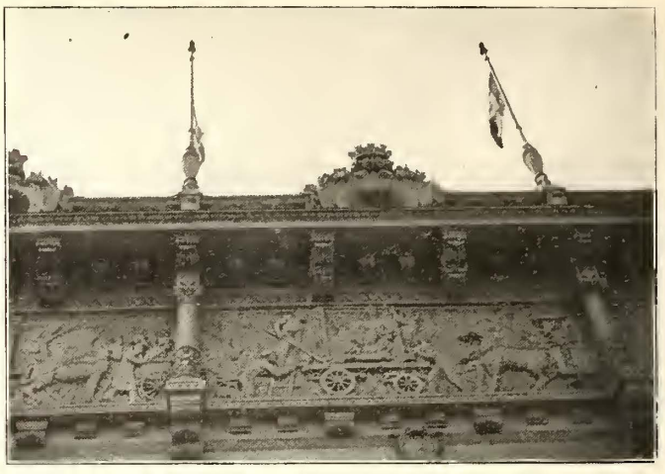
Reference was made in the June issue of the STREET RAILWAY JOURNAL to the series of decorative panels along the facade of the Transportation Building, in the Champ de Mars section of the Paris Exposition. These have at-

FRIEZE AT ENTRANCE TO TRANSPORTATION BUILDING, CHAMP DE MARS

tracted a great deal of attention and admiration, and we are glad now to be able to show a few of the principal groups relating to recent and relatively modern methods of travel

and the transportation of freight. No fewer than twenty of these panels ornament the long front of the building, and as each is about 15 ft. long and 9 ft. high, they attest the industry of their sculptor, Mr. Allar, even if they were not wholly successful from an artistic standpoint or from that of an engineer. But their designer is to be congratulated on the ease and grace with which he has grouped his figures and vehicles and given to all of them flowing lines that not only please the eye, but convey very forcibly the sense of activity and movement. The tableaux reproduced herewith deal more particularly with the achievements of the past century, and in three of them the omnibus, the tramway, the trolley car, the automobile and the bicycle play a very prominent part. As will be noted, the set shown begins with an abundant use of the power of man and beast; but in the finale, the horse has entirely disappeared, and the use of the bicycle is attributed solely to purposes of sport and recreation. Beneath these panels are twenty colossal figures in high relief, ten each side of the main portico, of which a view is here shown also. These "heroic" size figures, one on each pillar face, signed with different names, are intended to represent the motorman, the stage driver, the navvy, the signalman, the train conductor, and others of the leading types of men employed in the construction and operation of street car lines, railroads, bridges, etc.; and, on the whole, a most dignified effect has been happily produced. As a matter of fact, the Transportation Building is the most elaborately treated of all the large palaces on the Champ de Mars, if we except the Chateau d'Eau, which is not a palace, but a mere front to the water supply and condensing system of the power plant. In fact, the contrast between the handsome building devoted to transportation in the main Exposition and the primitive car barns bearing the same designation at Vincennes could not very well be sharper.





DECORATIVE PANELS, TRANSPORTATION BUILDING, SHOWING PROGRESS IN THE SCIENCE OF TRANSPORTATION

DECORATIVE PANELS, TRANSPORTATION BUILDING, SHOWING PROGRESS IN THE SCIENCE OF TRANSPORTATION

DECORATIVE PANELS, TRANSPORTATION BUILDING, SHOWING PROGRESS IN THE SCIENCE OF TRANSPORTATION

Third-Rail in the B. & O. Tunnel

After a long and thorough test of the overhead trolley, the Baltimore & Ohio Railroad Company has decided to install a third-rail system. The heavy combination of Z-bars which formed the overhead conductor will be removed and current for the electric locomotives will be supplied by a rail running outside the wheel rails. This rail is to be of the standard A. S. C. E. section and weigh 75 lbs. per yard. Four miles of double track will be equipped, extending from the northern to the southern side of the city of Baltimore.

According to the proposed plan, in the stations and at some of the crossings where special precautions are desirable the rail is sectionalized electrically. The Murphy safety third-rail system is here used. To minimize the danger of shocks to the workmen and others who may have occasion to use the tracks, the rail is paralleled on each side by a pine plank set on edge. There is a few inches clearance between these guards and the rail, and the top edge of the plank extends a little above the head of the rail.

The insulators consist of blocks of reconstructed granite. These have vertical recesses to receive a pin on a malleable iron casting, which forms the base and extends laterally far enough to support the guard planks. A chair on which the rail rests is leaded on the top of the granite block and completes the insulator.

Transportation Figures at Paris Exposition

The work done by the moving sidewalk and the third-rail road at the Paris Exposition has been very gratifying to the management and to the authorities. It appears that from April 15 to May 13, inclusive, the two systems carried no fewer than 799,479 paying passengers, of whom by far the larger number traveled on the sidewalk, although the trip costs 10 cents while the third-rail fare is but 5 cents. In the period named, one day was lost, April 21, owing to an accident on the transmission cables, and there was a little delay once or twice on the sidewalk due, for example, to the swelling and binding of some of the moving wooden platforms after the heavy rains; but in all other respects both the walk and the road carried their patrons with comfort, regularity and safety.

The greatest number of passengers carried in one day was 75,000, on May 13, when there were slightly over 300,000 people at the show and when the time of operation was ten hours. On Easter Day they carried 61,000 passengers. The travel increases with the growth of the crowds at the Exposition, and it would seem that it is safe to count on handling 25 per cent of all the visitors, for even those who have once ridden for pleasure come back again and again to bring friends and to reach different parts of the grounds quickly. Indeed it is stated by observers that the regular attendants at the Exposition, in care of exhibits, etc., are the best customers, using the services as part of their daily means of transit. We are indebted to M. Maréchal, manager of the two systems, and to Charles Leblanc, general manager of the Compagnie Generale de Traction, which is interested in the enterprises, for the above data. It may be added that the Westinghouse sub-station receiving the current from the transmission line from Issy les Moulineaux, as described already, is in most satisfactory operation, and that the duplicate plants in it have been practically completed. Tests have been made as to the current used, and will be repeated from time to time. The data from the sidewalk would show it to be quite economical of current, with little increase as the load of travel is augmented.

Double-Current Generators for Electric Railway Service

The Massachusetts Electric Companies, which have consolidated thirty-eight railroads and two lighting systems in eastern Massachusetts, propose to reduce the cost of operation of their extensive system by centralizing their generating stations. The first move in this direction will be on that part of their system in and around Salem, and will be made by the addition of polyphase apparatus to transmit power from the present Salem direct-current station to neighboring towns. Sub-stations will be located in Wakefield, Essex and Gloucester.

Two 800-kw double-current generators will be installed at Salem, direct coupled to engines, making probably the first case of direct-coupled double-current machines for railway service in this country. These machines may be run in parallel with the three 300-kw direct-current machines now in service at this point, although there is some doubt as to the advisability of so running them on account of the disturbing effects of wattless currents on the field strength of the double-current machines. Since this disturbing effect will not be felt on the direct-current machines, it may affect the division of the direct-current load between the two classes of machines. If this is so to a serious extent, it may be necessary to run the double-current machines on a separate set of busses and a separate load from the direct-current machines.

The Massachusetts Electric Companies own the Lowell & Suburban road with its pioneer polyphase transmission line from Lowell to Nashua. The new transmission will be carried out in the same manner to a large extent.

Street Car Building

(Stephenson Practice.)

BY CHARLES HENRY DAVIS, C. E.

VI.—Assembling—(Continued)

In the June issue of the STREET RAILWAY JOURNAL we gave the details of the bottoms for our two standard cars; namely, the Boston (closed) and the Brooklyn (open). Tables Nos. 33 and 34 give respectively the details of bodies for these standard cars, while Plates V. and VI. illustrate the various parts. As in Tables 31 and 32, each distinct part of the body is described, giving the material, the general dimensions, how made, on what tools and how assembled, all in consecutive order as each car is built in the shop. In using these tables they are to be read across the page line by line as in the case of any book. In column 1 the numerals indicate, in consecutive order, the number of distinctive pieces; where a letter follows the numeral it indicates another operation, but not another distinctive piece. Letters in column 4 are the same abbreviations of timbers as used on Plates I. and II. These tables are given on the following seven pages.

The Toledo Traction Company has just issued a time table for the running of its cars, in the form of a little folder, which contains also some particulars of the city, as well as a handsomely lithographed bird's eye view of Toledo, in which the routes of the company's system are shown. In this map the site of the Ohio Centennial and Northwestern Territory Exposition in 1902 is clearly shown.

TABLE NO. 33

DETAIL OF SIDES AND ENDS (BODY) OF BOSTON CLOSED CAR, IN THE ORDER OF ASSEMBLING

(25 ft. Body; Car No. 2; Fig. 3; Plates I. and V.)

Consecutive Number	Quantity	Name of Piece	Piece Number Plates I. and V.	Material See Plates I. and II.	Details: Quantity	Details: Name	Details: Reference Letter Plate V.	Dimensions	Observations and Particulars of How Used	Tools Usually Employed (Others can be used if convenience or necessity requires)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
33	8	**Side-posts** (Figs. 80, 81)	1002	A.	--	----------	--	5 ft. 11⅛ in. x 5 in. x 1⅝ in.	Are now (*see Table No. 31 and Plate IV.*) laid on one side of the car flooring opposite their respective positions; each one is previously prepared as follows:—	
					1	Gain	a	3½ x 1¼ in. x ¾ in.	For side belt-rail (1015), Figs. 94, 95	Car gainer
					1	Gain	b	3 in. x 2 in.	For side rib-rail (1017), Figs. 99, 100	Car gainer
					1	Tenon	c	1⅝ in. x 1¼ in.	To tenon into mortise of side-sill, with hole for dowel-pin	Car gainer
					1	Tenon	d	1⅝ in. x 1 in.	To tenon into mortise of side top-rail (1005), Fig. 93	Car gainer
					2	Rabbets	e		For the window-sash to slide in, leaving a bead (g) on the outside, called the outside window-stop (1034). There are also	Routing machine
34	16	**Post parting-strips** (Fig. 90)	1035	C.	--	----------	--	2 ft. 10 in. x 1¼ x ⅝ x ¼ in.	Shown at (f) Figs. 80, 81, screwed to side-posts; they are temporarily attached merely to indicate their position, and when the sashes are fitted later they are secured with 64 No. 7 x ⅞ in. bronze screws	
35	16	**Sash parting-strips** (Not Ill.)	1037		--	----------	--	2 ft. 3 in. x ¼ in. x ¼ in.	Nailed to the posts along the rabbet (f) from below the belt-rail to the floor, to guide the sash when it is lowered; they are clearly seen in Fig. 75	
36	1	**Side belt-rail** (Figs. 94, 95)	1015	A.	--	----------	--	24 ft. 7¾ in. x 4 in. x 1¾ in.	Is now fitted to above side-posts, the gains (a) of the posts interlocking with the	
					8	Gains	a	1⅝ in. wide	Of the belt-rail; and, being further secured by small wooden wedges, are also screwed through	Multiple gainer
					16	Holes	b		With 8 No. 14 x 2 in. and 8 No. 14 x 3 in. steel screws to side-posts	Borer or multiple spindle drill
					1	Rabbet	c	1¾ in. x ½ in.	Runs the whole length of the belt-rail to receive the convex-panel	Molding machine
					1	Rabbet	d	½ in. x 1 in.	The whole length of the rail, for the window-sashes to rest on	Molding machine
					2	Tenons	--	3½ in. x 2½ in.	To fit into mortises (a) in corner-posts (1001), Figs. 76 to 79	End tenoner
					27	Mortises	--	1½ in. x ½ in. x 5-16 in.	On under side of rail for convex-panel ribs (1021), Fig. 86, to tenon into. For securing belt-rails to corner-posts, *see Con. No. 56 c*	Hollow chisel mortiser
37	2	**Side-post strap-bolts** (Fig. 124)	1501	W. I.	--	----------	--	9⅜ in. x ½ in.	Are now screwed to side-posts with 16 lag screws 1⅝ in. x ¼ in., after which the side-posts are erected upon one of the side-sills, the tenons being well white-leaded before being driven into their respective mortises, the strap-bolts well tightened up and the side-posts draw-pinned	
	6	**Side-post strap-bolts** (Fig. 125)	1501	W. I.	--	----------	--	9 9-16 x ½ in.		
37a	8	**Side-posts**	1002	A.	--	----------	--		The other side consisting as above of:—	
37b	16	**Post parting-strips**	1035	C.	--	----------	--			
37c	16	**Sash parting-strips**	1037		--	----------	--			
37d	1	**Side belt-rail**	1015	A.	--	----------	--			
37e	8	**Side-post strap-bolts**	1501	W. I.	--	----------	--		Is now put together and similarly erected, after which:—	
38	2	**Side rib-rails** (Figs. 99, 100)	1017	A.	--	----------	--	24 ft. 7¾ in. x 3½ x 2⅜ in.	Are screwed to the side posts, and secured with 16 No. 14 x 2 in. and 16 No. 14 x 3 in. steel screws. Each one has:—	
					8	Gains	a	1⅝ in. x 3-16 in.	To interlock with corresponding gains (b) of the side-posts	Multiple gainer
					2	Gains	a_1	2¾ in. x 3-16 in.	To interlock with corresponding rabbets (b) of the corner-posts (1001)	End tenoner
					27	Gains	b	1½ in. x 2½ in. x ⅜ in.	To receive the concave-panel ribs (1022), Fig. 87	Multiple gainer
					1	Rabbet	c	1 in. x ½ in.	To receive the convex-panel (1027)	Molding machine
					27	Rabbets	d	1½ in. x ⅞ in. x ½ in.	To receive the convex-panel ribs (1021), Fig. 86	Hollow chisel mortiser
					36	Holes	e		For screws to secure side fender-rail (1019), Fig. 101, to side rib-rail	Borer or multiple spindle drill
					4	Holes	f		For screws to secure the side rib-rail to corner posts	Borer or multiple spindle drill
					16	Holes	g		For screws to secure the side rib-rail to side posts as above	Borer or multiple spindle drill
					1	Rabbet	h	2¼ in. x ⅜ in.	To receive the concave-panel (1028), Fig. 113	Molding machine
									For securing side rib-rails to corner-posts. (*See Con. No. 56 d*)	
39	42	**Convex-panel ribs** (Fig. 86)	1021	A.	--	----------	--	17¼ in. x 1½ in. x ¾ in.	Each one having:—	Shaper
					1	Tenon	a	1½ in. x ½ in. x 5-16 in.	To fit into mortises on under side of side belt-rail	Double end tenoner and gainer
					1	Tenon	b	1½ in. x ⅞ in. x ½ in.	To fit into rabbets (d) of side rib-rail, to which they are screwed with 42 No. 12 x 1 in. steel screws. There are altogether 54 side panel-ribs, but the three next to each corner-post are put in later. (*See Con. No. 57 a*)	Double end tenoner and gainer
40	42	**Concave-panel ribs** (Fig. 87)	1022	A.	--	----------	--	10 in. x 1½ in. x ¾ in.	Each with:—	Shaper
					1	Tenon	a	1½ in. x ⅜ in.	To fit in mortises (d) of side-sills (Fig. 32, Plate IV.)	End tenoner
					1	Hole	b		For No. 14 x 2 in. screws to secure the ribs to the rib-rails. There are also 54 of these ribs, but the three next each corner-post are put in later. (*See Con. No. 57 b*)	Borer
41	4	**Convex-panel cleats** (Not Ill.)	1024	A.	--	----------	--	16 in. x 1½ in. x 1 in.	Glued and screwed with 16 No. 12 x 1¾ in. screws to the sixth side-post on opposite ends of the body (2 on each post) for securing the convex-panel splices	Shaper and borer
42	4	**Concave-panel cleats** (Fig. 88)	1025	A.	--	----------	--	10 in. x ¾ in. x 1 in.	Glued and screwed with 16 No. 12 x 1¾ in. screws to the sixth side-post on opposite ends of the body (2 on each post) for securing the concave-panel splices.	Shaper and borer
43	2	**Corner-posts** (Figs. 77, 78)	1001a	A.	--	----------	--	6 ft. 1⅞ in. x 8⅞ x 5 x 4 in.	And	
43a	2	**Corner-posts** (Figs. 76, 79)	1001b	A.	--	----------	--	6 ft. 1⅞ in. x 8⅞ x 5 x 4 in.	Are now set in the side-sill mortises (j), Fig. 33, Plate IV., but not fastened until later. (*See Con. No. 56 b*). Each one is previously prepared as follows:—	
					1	Mortise	a	3½ in. x 2½ in.	To receive tenon of side belt-rail (1015)	Hollow chisel mortiser
					1	Rabbet	b	3 in. x 2 in.	To interlock with gain (a_1) of side rib-rail (1017), Figs. 99, 100	Car gainer
					1	Tenon	c	3½ in. x 1¼ in.	To fit into mortise (j) of the side-sill	Double end tenoner and gainer

					1	Gain	d	2½ in. x 1 in.	To receive the end of the side top-rail (1005), Fig. 93	Double end tenoner and gainer
					1	Gain	e	4¼ in. x ½ in.	To receive the end of the letter-board (1010), Figs. 96, 97	Double end tenoner and gainer
					1	Rabbet	f	5-16 in. deep	For the window-sash to slide in	Routing machine
					1	Mortise	g	3¼ in. x 1¼ in. x ½ in.	To receive the tenon of the end belt-rail (1016), Fig. 120	Hollow chisel mortiser
					1	Mortise	h	2½ in. x 1¼ in. x ½ in.	To receive the tenon of the end rib-rail (1018), Fig. 121	Hollow chisel mortiser
					1	Rabbet	i	3¼ in. x ⅜ in.	To receive upper end-panel (1029)	Planer
					1	Mortise	j	1¾ in. x 9-16 in. x 1¼ in.	To receive nut of corner-post joint-bolt (1503), Fig. 128	Hollow chisel mortiser
					1	Mortise	k	2 in. x ⅜ in.	To receive tenon of end-lining top-rail (4023)	Hollow chisel mortiser
					2	Mortises	l	2¼ in. x ⅜ in.	To receive tenons of end-lining middle-rail (4024)	Hollow chisel mortiser
					1	Groove	m		To bury the trolley wire in	Routing machine
					1	Rabbet	n	4¼ in. x 2½ in. x ½ in.	To receive end window-lintel (1012), Fig. 118	Hollow chisel mortiser
					1	Rabbet	o	5-16 in. deep	From the top of the post to the belt-rail, to receive the end sash	Planer
					1	Mortise	p	1 in. x ⅜ in.	For sliding-door rear-track (4509)	Hollow chisel mortiser
					1	Gain	r	3⅜ in. x 1 in.	To receive the end of the end top-rail (1006), Figs. 108 to 111	End tenoner
					1	Rabbet	s	2 in. x ½ in.	To receive convex-panel (1027)	Shaper
									There are also :—	
44	4	**Post parting-strips** (Fig. 91)	1035	C.	--	----------	--		Shown at (t) Fig. 78, and	
45	2	**Inside window-stops** (Fig. 92)	1033	C.	--	----------	--		Shown at (u) Fig. 78, which are temporarily attached merely to indicate their position. With the bead along the outer edge of the post, called the outside window-stop (1034), they make two grooves, in one of which the window-sash slides, and in the other the window-shade. When the sashes are fitted later, they are secured with 26 No. 7 x ⅞ in. bronze screws	
46	2	**Door-posts (thick) on left hand** * (Figs. 82, 83)	1003	A.	--	----------	--	7 ft. 0⅞ in. x 3⅛ in. x 2½ in.	Are now set in the end-sill mortises (i), Fig. 36, Plate IV., but not fastened until later. (*See Con. No. 56 a*). Each one has been previously prepared as follows :—	
					1	Tenon	a	2½ in. x ½ in.	To fit into mortise of the end-sill, with two holes for dowel-pins	Double end tenoner and gainer
					1	Tenon	b	2½ in. x ½ in.	To fit into mortise of the end top-rail (1006), Fig. 108, with two holes for dowel-pins	Double end tenoner and gainer
					1	Mortise	c	3¼ in. x ½ in.	To receive tenon of end belt-rail (1016), Fig. 120	Hollow chisel mortiser
					1	Mortise	d	2½ in. x ½ in.	To receive tenon of end rib-rail (1018), Fig. 121	Hollow chisel mortiser
					1	Rabbet	e		To receive end of door-lintel (1011), Fig. 119	Hollow chisel mortiser
					1	Mortise	f		To receive tenon of door-lintel (1011), Fig. 119	Hollow chisel mortiser
					1	Rabbet	g	4¼ in. x ½ in.	To receive end window-lintel (1012), Fig. 118	Hollow chisel mortiser
					1	Rabbet	h	5-16 in. deep	For the stationary end window-sash to fit in	Planer
					1	Rabbet	i	⅜ in. deep	To receive the upper and lower end-panels (1029, 1030)	Planer
					1	Mortise	j	1 in. x ⅜ in.	For the end of the sliding-door top-rack (4508) to fit in	Hollow chisel mortiser
47	2	**Door-posts (thin) on right hand** (Figs. 84, 85)	1004	A.	--	----------	--	7 ft. 0⅞ in. x 2½ in. x 1¾ in.	Are now set in the end-sill mortises (j), Fig. 36, Plate IV., but not fastened until later. (*See Con. No. 56 a*). Each one has been previously prepared as follows :—	
					1	Tenon	a	2½ in. x ½ in.	To fit into mortise of the end-sill, with two holes for dowel pins	Double end tenoner and gainer
					1	Tenon	b	2½ in. x ½ in.	To fit into mortise of the end top-rail (1006), Fig 108, with two holes for dowel-pins	Double end tenoner and gainer
					1	Mortise	c	3¼ in. x ½ in.	To receive tenon of end belt-rail (1016), Fig. 120	Hollow chisel mortiser
					1	Mortise	d	2½ in. x ½ in.	To receive tenon of end rib-rail (1018), Fig. 121	Hollow chisel mortiser
					1	Rabbet	--		Not shown, to receive end of door-lintel, corresponding to (e) Fig. 83	Hollow chisel mortiser
					1	Mortise	--		Not shown, to receive tenon of door-lintel, corresponding to (f) Fig. 83	Hollow chisel mortiser
					1	Rabbet	e	4¼ in. x ½ in.	To receive end window-lintel (1012), Fig. 118	Hollow chisel mortiser
					1	Rabbet	f	5-16 in. deep	For the stationary end window-sash to fit in	Planer
					1	Rabbet	g	⅜ in. deep	To receive the upper and lower end-panels (1029, 1030)	Planer
					1	Rabbet	i	1 in. x ⅜ in.	For the end of the sliding-door rear-track (4509) to fit in	Hollow chisel mortiser
					1	Rabbet	j	1 in. x ⅜ in.	For the end of the sliding-door rear-sheave guide (4515) to fit in	Hollow chisel mortiser
					1	Pocket	k		To clear sliding-door rear-sheave (4513)	Borer
									There are also :—	
48	2	**Inside window-stops** (Fig. 89)	1033	C.	--	----------	--		Also shown at (h) Fig. 84, which are temporarily attached to show their position. When the sashes are later fitted, the window-stops are finally secured with 8 No. 7 x ⅞ in. bronze screws	
49	4	**End belt-rails** (Fig. 120)	1016	A.	--	----------	--	2 ft. 1⅝ in. x 3⅞ in. x 1¾ in.	Each having :—	
					1	Tenon	a	3¼ in. x 1¼ in.	Tenoned into corner-post mortise (g), Fig. 79	Double end tenoner and gainer
					1	Tenon	b	3¼ in. x 1¼ in.	Tenoned into door-post mortise (c), Figs. 82, 85	Double end tenoner and gainer
					1	Rabbet	c	⅜ in. deep	To receive the upper end-panel (1029)	Planer
					1	Rabbet	d	1 in. x ½ in.	For the window-sash to rest on when closed	Planer
					3	Rabbets	e	2 in. x 1½ in. x ½ in.	To interlock with the body end-ribs (1023), Fig. 131 ; these rails are firmly secured and pinned later, when the whole body framework is thoroughly squared. (*See Con. No. 55 a*)	Hollow chisel mortiser
50	4	**End rib-rails** (Fig. 121)	1018	A.	--	----------	--	2 ft. 1⅛ in. x 2 in. x 1¼ in.	Each having :—	
					1	Tenon	a	2½ in. x 1¼ in.	Tenoned into corner-post mortise (h), Fig. 79	Double end tenoner and gainer
					1	Tenon	b	2½ in. x 1¼ in.	Tenoned into door-post mortise (d), Figs. 82, 85	Double end tenoner and gainer
					3	Gains	c	2 in. x ½ in.	To interlock with the body end-ribs (1023), Fig. 131 ; these rails are pinned later. (*See Con. No. 55 b*)	Double end tenoner and gainer
51	2	**Door-lintels** (Fig. 119)	1011	A.	--	----------	--	2 ft. 5 in. x 5¾ in. x 1¾ in.	Each having :—	
					1	Tenon	a		Tenoned into door-post mortises (f), Fig. 83, and gained with door-post rabbet (e), Fig. 83	Double end tenoner and gainer
					1	Tenon	b		Tenoned into door-post mortises, and gained with door-post rabbets of thin door-posts, Figs. 84, 85, not shown, but corresponding to those of Figs. 82, 83. These are each pinned to the door-posts with four hickory dowel-pins	Double end tenoner and gainer
52	4	**End window-lintels** (Fig. 118)	1012	A.	--	----------	--	2 ft. 5 in. x 4¼ in. x ½ in.	Fitted to corner-post rabbets (n), Fig. 79, thick door-post rabbets (g), Fig. 83, and thin door-post rabbets (e), Fig. 84, to all of which they are screwed with 20 No. 12 x 1¼ in. steel screws	
53	2	**End top-rails** (Figs. 108 to 111)	1006	A.	--	----------	--	7 ft. 2 in. x 5½ in. x 1¾ in.	In two pieces, spliced, and screwed together with 16 No. 14 x 1½ in. steel screws ; each one has :—	
					2	Gains	a	3⅜ in. x ¾ in.	Interlocked with corner-post gain (r), Figs. 77, 79, and secured with 12 No. 14 x 3 in. steel screws	Double end tenoner and gainer
					2	Gains	b		To receive the ventilator plain-bottom-rail (2002)	Car gainer
					2	Rabbets	c	2 in. x 1¼ in. x ⅝ in.	For ventilator end-corner-post (2004) shown in Fig. 107	Hollow chisel mortiser
					2	Mortises	d	2½ in. x ½ in.	To receive tenons (b) of door-posts, Figs. 82 to 85, which are draw-pinned	Hollow chisel mortiser

* In speaking of "right hand" and "left hand," the reader is supposed to be in the center of the car, and in this case looking toward the door. It will then be seen that, contrary to usual custom, the door, when being opened, slides to the right.

TABLE NO. 33—*Continued*

Consecutive Number	Quantity	Name of Piece	Piece Number Plates I. and V.	Material See Plates I and II.	Details: Quantity	Details: Name	Details: Reference Letter Plate V.	Dimensions	Observations and Particulars of How Used	Tools Usually Employed (Others can be used if convenience or necessity requires)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
					4	Holes	e	½ in. diam.	For trolley wires to pass through	Borer or multiple spindle drill
					1	Rabbet	f	¾ in. x ⅝ in.	For ventilator end-sash (4007) to rest on	Shaper
									There are also screwed to the end top-rails:—	
54	14	**Furring-pieces** (Fig. 114 to 116)	1038	A.	--	----------	--		Of various shapes and sizes, also seen in place in Fig. 111, secured with 32 No. 14 x 1½ in. to 3½ in. steel screws. These are to fasten the inside door-head lining to	
55	2	**Side top-rails** (Fig. 93)	1005	Y. P.	--	----------	--	25 ft. 0 in. x 3½ in. x 3¼ in.	Are now adjusted to the side-posts, the tenons of the latter entering the mortises on the underside of the rails. They are secured later. (*See Con. No. 58 a*). Each rail has:—	
					27	Gains	a	1⅛ in. x 1¼ in.	For the lower deck rafters to fit in	Double end tenoner and gainer
					1	Rabbet	b	⅝ in. x ½ in.	To receive the letter-board (1010). Figs. 96, 97	Molding machine
					8	Gains (not marked in ill.)	c	1½ in. x 1¼ in.	For the lower deck compound carlins to fit in	
									The body framework is now squared, after which several of the previous operations are completed, as follows:—	
55a	--	**End belt-rails**	1016	----	--	----------	--		Are secured to corner and door-posts with 8 hickory dowel-pins (*See Con No. 49*)	
55b	--	**End rib-rails**	1018	----	--	----------	--		Are secured to corner and door-posts with 12 hickory dowel-pins. (*See Con. No. 50*)	
56	4	**Door-post strap-bolts** (Fig. 126)	1504	W. I	--	----------	--	12⅝ in. x ½ in.	Fastened to door-posts with 8 lag screws 1⅝ in. x ¼ in., after which the four	
56a	--	**Door-posts**	1003,4	----	--	----------	--		(*Con. Nos. 46, 47*) are bolted to end-sills with above strap-bolts, and pinned with 8 hickory dowel-pins	
56b	--	**Corner-posts**	1001a,b	----	--	----------	--		(*Con. Nos. 43, 44*) are now pinned to side-sills with 8 hickory dowel-pins. (*See Con. No. 58* for completion)	
56c	--	**Side belt-rails**	1015	----	--	----------	--		(*Con No. 39*) are now secured to corner-posts with 4 No. 14 x 3 in. and 4 No. 14 x 2 in. steel screws	
56d	--	**Side rib-rails**	1017	----	--	----------	--		(*Con. No. 38*) are now secured to corner-posts with 4 No. 14 x 3 in. and 4 No. 14 x 2 in. steel screws. Work then proceeds as follows:—	
57	8	**Body end-ribs** (Fig. 131)	1023	A.	--	----------	--	2 ft. 10¼ in. x 1½ in. x ⅞ in.	And	
	4	**Body end-ribs** (Fig. 131)	1023	A.	--	----------	--	2 ft. 6⅛ in. x 1½ in. x ⅞ in.	Each having:—	
					1	Gain	a	2 in. x ⅜ in.	To fit into rabbets (e) of end belt-rails (1016). Fig. 120	Car gainer
					1	Gain	b	2 in. x ⅜ in.	To interlock with gain (c) of end rib-rails (1018), Fig. 121	Car gainer
					1	Gain	c	1½ in. x ⅜ in.	To interlock with rabbet (h) of end sills (2), Fig. 36. The gain (c) of the four shorter ribs interlocks with rabbet (n) of side-sills (1), Fig. 33. The ribs are secured with 36 No. 12 x 1 in. steel screws	Car gainer
57a	12	**Convex-panel ribs** (Fig. 86)	1021	A.	--	----------	--	17¼ in. x 1½ in. x ¾ in.	Fitted same as the 42 ribs, *Con. No. 39*, these being the three next to each corner-post, and secured with 12 No. 12 x 1 in. steel screws	
57b	12	**Concave-panel ribs** (Fig. 87)	1022	A.	--	----------	--	10 in. x 1½ in. x ¾ in.	Fitted same as the 42 ribs, *Con. No. 40*, these being the three next to each corner-post, and secured with 12 No. 14 x 2 in. steel screws	
58	4	**Side-braces** (Fig. 129)	1026	A.	--	----------	--	2 ft. 11¼ in. x 2½ x 1¾ in.	Each with:—	
					3	Gains	a	1½ in. x ¾ in.	For convex-panel ribs; screwed to corner-posts with 4 No. 20 x 5 in. screws to side rib-rails with 4 No. 20 x 4 in. screws, and to convex-panel ribs with 12 No. 12 x 1¼ in. steel screws	Car gainer
58a	--	**Side top-rails**	1005	----	--	----------	--		(*Con. No. 55*) are now pinned to side-posts, and fitted and screwed to corner-posts with 8 No. 14 x 3 in. steel screws	
									The body at this stage is accurately represented by Fig. 75	
59	2	**Concave-panels** (Fig. 113)	1028	P.	--	----------	--	25 ft. 0 in. x 17⅜ in. x ⅜ in.	In two pieces, spliced, the splicing being made at the side-posts with the panel-cleats (1025) (*See Con No 42*). The panels, after being bent on a former and dried, are glued, white-leaded, and nailed to the corner and side-posts, the rib-rails, side-sills and panel-ribs	
60	72	**Side-sill watersheds** (Not Ill.)	1052	P.	--	----------	--	6⅝ in. x ¾ in. x ¾ in.	Glued to panels and side-sills between all the panel-ribs	
61	--	**Linen scrim**	----	----	--	----------	--		Is now glued to the concave panels, lapping on to ribs, posts, rails and side-sills	
62	2	**Convex-panels** (Fig. 107)	1027	P.	--	----------	--	24 ft. 8 in. x 18½ in. x ½ in.	In two pieces, spliced same as the concave-panels. They are also glued, white leaded and nailed to the corner and side-posts, the belt and rib-rails and the panel-ribs. They are also screwed to corner and side-posts with 100 No. 10 x 1¼ in. steel screws	
63	72	**Rib-rail watersheds** (Not Ill.)	1051	P.	--	----------	--	6⅝ in. x 11-16 in. x 11-16 in.	Glued to panels and rib-rails between all the panel-ribs	
64	--	**Linen scrim**	----	----	--	----------	--		Is now glued to the convex-panels, lapping onto ribs, posts and rails	
65	4	**Lower end-panels** (Fig. 107)	1030	P.	--	----------	--	1 ft. 9 in. x 2 ft. 4½ in. x ⅜ in.	Glued, white-leaded and nailed to the corner and door-posts, the end rib-rails, end-sills and end-ribs	
66	4	**Upper end-panels** (Fig. 107)	1029	P.	--	----------	--	2 ft. 2 in. x 1 ft. 7 in. x ⅜ in.	Glued, white-leaded and nailed to the corner and door-posts, the end belt and rib-rails, and the panel ribs. They are also screwed to the corner-posts with 20 No. 10 x 1¼ in. screws	
67	--	**Linen scrim**	----	----	--	----------	--		Is now glued to the end-panels, lapping onto posts, rails, end-sills and ribs	
68	8	**Furring-pieces** (Fig. 117)	1038	A.	--	----------	--		Of various shapes and sizes, as shown, screwed to end top-rail (100b) with 20 No. 14 steel screws; they are used in connection with the wiring	
69	2	**Furring-pieces** (Fig. 138)	1038	A.	--	----------	--		For sliding-door top-track (4508), screwed to end top-rail	
70	2	**Furring-pieces** (Fig. 139)	1038	A.	--	----------	--		For sliding door seat-track (4509), screwed to end top-valance (1013)	
71	2	**End top-valances** (Fig. 112)	1013	P.	--	----------	--	⅜ in. thick	Glued and nailed to end top-rail, side and door-posts and end window-lintels	
72	2	**Letter-boards** (Figs. 96, 97)	1010	A.	--	----------	--	25 ft. 0¾ in. x 7 in. x 1 in.	Screwed through	
					90	Holes	a		To side top-rails with No. 12 x 1½ in. steel screws, and through	Borer or multiple spindle drill

					60	Holes	b		To corner and side-posts with No. 12 x 1½ in. steel screws. There are also in each one :	Borer or multiple spindle drill
					45	Holes	c		For screws to secure the drip-rails (1014). *See Con. No. 75*	Borer or multiple spindle drill
73	2	**Side fender-rails** (Fig. 101)	1019	A.	--	----------	--	25 ft. 2½ in. x 3 in. x 1⅞ in.	Screwed to side rib-rails through holes (e), Figs. 99, 100, with 72 No. 14 x 3 in. steel screws	
74	4	**End fender-rails** (Fig. 122)	1020	A.	--	----------	--	2 ft. 6½ in. x 1¼ in. x 1¼ in.	Screwed to end rib-rails (Fig. 121) with 24 No. 14 x 1½ in. to 2½ in. steel screws	
75	2	**Drip-rails** (Fig. 98)	1014	A.	--	----------	--	24 ft. 9 in. x 1¾ in. x ⅞ in.	Screwed through (c) Fig. 97 to letter-boards with 90 No. 12 x 2 in. steel screws	
76	4	**Corner-post angle-plates** (Fig. 127)	1511	W. I.	--	----------	--		Screwed to corner posts and top end-rails with 16 No. 16 x 2½ in. steel screws	
77	2	**Belt-rail bands** (Not Ill.)	1505	W. I.	--	----------	--	⅞ in half-round	Screwed to side and end belt-rails with 152 No. 12 x 1½ in. steel screws	
78	2	**Fender-guards** (Not Ill.)	1506	W. I.	--	----------	--	⅞ in. half-round	Screwed to side and end fender-rails with 152 No. 12 x 1½ in. steel screws	
79	20	**Convex-panel iron-straps** (Fig. 141)	1507	W. I.	--	----------	--	1¼ in. x 3-32 in.	Screwed through convex-panels at each corner and side-post, between belt and fender-rails, with 160 No. 10 x 1¼ in. steel screws; these and the following straps are all leaded before putting on	
80	20	**Concave-panel iron-straps** (Fig. 142)	1508	W. I.	--	----------	--	1¼ in. x 3-32 in.	Screwed through the concave-panels at each corner and side-post, from fender-rail to bottom of the panel, with 160 No. 10 x 1¼ in. steel screws	
81	4	**Upper end-panel iron-straps** (Fig. 143)	1509	W. I.	--	----------	--	1 in. x 3-32 in.	Screwed to corner posts over the edges of the upper end panels with 32 No. 10 x 1¼ in. steel screws	
82	4	**Lower end-panel iron-straps** (Fig. 144)	1510	W. I.	--	----------	--	1¼ in. x 3-32 in.	Screwed to door-posts over the edges of the lower end-panels with 36 No. 10 x 1¼ in. steel screws	
83	8	**Corner-post ½ round-moldings** (Not Ill.)	1031	P.	--	----------	--	1½ in. wide	Nailed to sides and ends of corner-posts, from belt-rail to end top-valance	
84	4	**Door-post ½ round-moldings** (Not Ill.)	1032	P.	--	----------	--	1½ in. wide	Nailed to door-posts from end top-valance to fender-rail	
85	4	**Platform step-hanger brackets** (Fig. 123)	1512	C. I.	--	----------	--		Screwed to corner posts, side and end-sills with 44 No. 18 x 1¾ in. steel screws. They are also further secured by 4 bolts in holes (a), 6¼ in. x ½ in., countersunk heads, which pass through the end-sills and overhang truss-rod anchor-irons. (*See Con No. 24, Table 31*)	
86	4	**Corner-post joint-bolts** (Fig. 128)	1503	W. I.	--	----------	--	17 in. x ½ in.	Are now inserted through a hole in underside of platform step-hanger bracket, through end sill hole (c), Fig. 36, Plate IV., through side-sill hole (k), Figs. 32, 33, Plate IV., and into the corner-post, being then secured by the nut inserted in the hole (j) in the corner-post (Fig. 79). This completes *Con. No. 50 b*	
87	36	**Sash-rests** (Not Ill.)	1053	A.	--	----------	--	6 in. x ¾ in. x ¾ in.	Nailed to the bottom of the side-sills for the window-sashes to rest on when lowered	
88	2	**Overhang truss rod queen-posts** (Fig. 32, Plate IV.)	516	C. I.	--	----------	--	7 in. x 7¼ in. x 1¾ in.	Screwed to side-sills and secured with 8 lag screws, 2½ in. x ½ in. (*See Con. No. 24, Table 31*)	
89	2	**Truss-rods** (Not Ill.)	515	W. I.	--	----------	--	1 in. diam.	In two pieces, joined together with :—	
90	2	**Overhang truss-rod turn-buckles** (Fig. 32, Plate IV.)	518	M. I.	--	----------	--	9 in. x 2¼ in. x 2 in.	The ends of the rods being passed through the anchor-irons (517) (*see Con. No. 24, Table 31*) and secured with nuts, are then passed over the queen posts and joined together with the turn-buckles, which are screwed up tight	
91	4	**Seat-rail cleats** (Fig. 132)	1056	A.	--	----------	--	23¾ in. x 1¼ in. x ⅞ in.	Screwed to corner posts with 20 No. 10 x 2½ in. steel screws; a shoulder at the bottom serves to support the back seat-supporting-rail (1054), Fig. 102	
92	2	**Back seat-supporting-rails** (Fig. 102)	1054	A.	--	----------	--	24 ft. 5¾" x 3¼" x 1½" & ⅝"	Screwed to side-posts and seat-rail cleats with 20 No. 14 x 1½ in. and 20 No. 14 x 2½ in. screws. Each rail has :—	
					1	Shoulder	a	1¾ in x ⅞ in.	Its whole length to support the seat-lids (1060), Fig. 136	Molding machine
					8	Rabbets	b	1½ in x ⅞ in. x ½ in.	To receive the seat-bearing cross-bars (1059), Fig. 137	Hollow chisel mortiser
93	2	**Lock-rails** (Fig. 103)	1055	A.	--	----------	--	24 ft. 5¾ in. x 4¼ in. x ⅞ in.	Each having :—	
					8	Gains	a	4¼ in. x 1⅝ in. x ¼ in.	To fit side-posts and seat-rail cleats to which they are screwed with 40 No. 14 x 1½ in. steel screws	Car gainer
94	16	**Seat-legs** (Fig. 134)	1058	A.	--	----------	--	13⅞ in. x 1½ in. x ¾ in.	Each having :—	
					2	Round tenons	--		To fit into corresponding holes in the floor and the seat-bearing cross-bars (1059). They are now glued and driven into the holes in the flooring-boards, after which :—	End tenoner and lathe
95	16	**Seat-bearing cross-bars** (Fig. 137)	1059	A.	--	----------	--	15½ in. x 1½ in. x 1½ & ⅝ in.	Each having :—	
					1	Tenon	a	⅞ in. x ½ in.	Are fit into rabbets (b) of the back seat-supporting-rails (1054), and are then screwed to them with 32 No. 10 x 1½ in screws	End tenoner
					1	Tenon	b	¾ in. x ½ in.	To fit into similar rabbets of the front seat supporting-rail (1057), Fig. 104	End tenoner
					1	Hole	c	¾ in. diam.	(Not seen), into which the top tenon of the seat-leg is driven, being well glued first	Horizontal borer
96	2	**Front seat-supporting-rails** (Figs. 104, 105)	1057	A.	--	----------	--	24 ft. 3⅞ in. x 2 in. x 1⅛ in.	Each having :—	
					8	Rabbets	a	1½ in. x ¾ in. x ½ in.	To receive the tenons (b) of the seat-bearing cross-bars (1059), to which they are screwed with 32 No. 10 x 1½ in. screws	Hollow chisel mortiser
					1	Rabbet	b	¾ in. x ½ in.	Running its whole length, to receive the seat-lids (1060), Fig. 136	Molding machine
					1	Bead	c	½ in. x ⅛ in.	Running its whole length, to secure the front seat-supporting-rail facia (4121)	Molding machine
97	18	**Seat-lids** (Fig. 136)	1060	A. & P.	--	----------	--	2 ft. 8¼ in. x 15 in. x ⅜ in.	Being composed of :—	
97a	54	**Seat-lid boards** (Not Ill.)	1062	P.	--	----------	--	10¾ in. x 15 in. x ⅜ in.	Joined together and screwed to	
98	36	**Seat-lid battens** (Not Ill.)	1061	A.	--	----------	--	2 ft. 6¾ in. x 2½ in. x ½ in.	With 216 No. 10 x ¾ in. steel screws	
99	4	**Mu -blocks** (Fig. 135)	1067	Y. P.	--	----------	--	6½ in. x 2½ in. x ½ in.	Screwed to the floor near the door-posts	
100	4	**Door stop-blocks** (Fig. 140)	1049	A.	--	----------	--		Screwed to corner-posts with 4 No. 14 x 2 in. screws	
101	2	**Plain advertising-rack rails** (Fig. 106)	1069	A.	--	----------	--	24 ft. 4 in. x 4¾ in. x ⅞ in.	Screwed through	
					32	Holes	a		To side-posts with No. 14 x 2 in. steel screws, and	Borer or multiple spindle drill
					54	Holes	b		To side top-rails with No. 14 x 2 in. steel screws. Each one has also	Borer or multiple spindle drill
					45	Holes	c		Through which the screws (c) (*Con. Nos. 72, 75*), can be got at without taking down the whole rail	Borer or multiple spindle drill
					1	Rabbet	d	½ in. x ⅛ in.	Running its whole length, for the lower-deck ceiling-panel (4075)	Molding machine
					1	Rabbet	e	½ in. x ¼ in.	Running its whole length, for wires to the electric-bell push-buttons (4538)	Molding machine
102	2	**Door-sill plates** (Fig. 146)	1513	C. I.	--	----------	--		Screwed to end-sills between door posts, and secured with 22 No. 14 x 1 in. screws	
103	2	**Door guide-plates** (Fig. 145)	1514	C. I.	--	----------	--		Screwed to end sills between corner-posts and thin door-posts (1004), and secured with 6 No. 14 x 1 in. steel screws	
									The body is now ready to receive the roof, for description of which see *Con. No. 104, Table No. 35 and Plate VII.*	

Number of Distinctive Pieces	71	(Column 1)
Total Number of Pieces	746	(" 2)
Number of Bolts	4	(" 6 and 10)
Number of Screws (about)	2150	(" 6 and 10)
Number of Nails	?	
Total	2900 +	

Note.—Pieces described under Con. Nos. 91 to 100 are not usually assembled at this stage, but as they cannot be classified with "Cabinet Work," they are brought in here. Reference will be made to them further on when describing other pieces or operations to which they are accessory.

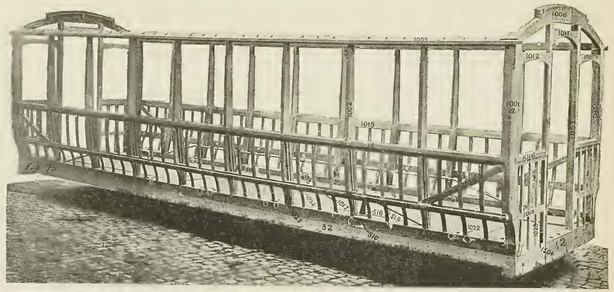
TABLE NO. 34

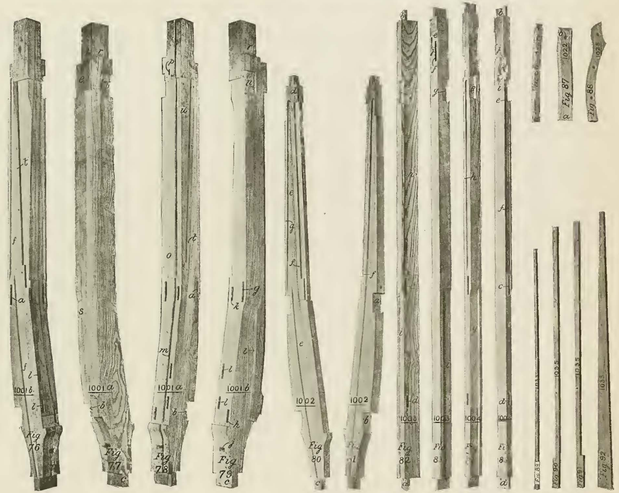
DETAIL OF SIDES AND ENDS (BODY) OF BROOKLYN OPEN CAR, IN THE ORDER OF ASSEMBLING

(12 benches; Car No. 4; Fig. 5; Plates II. and VI.)

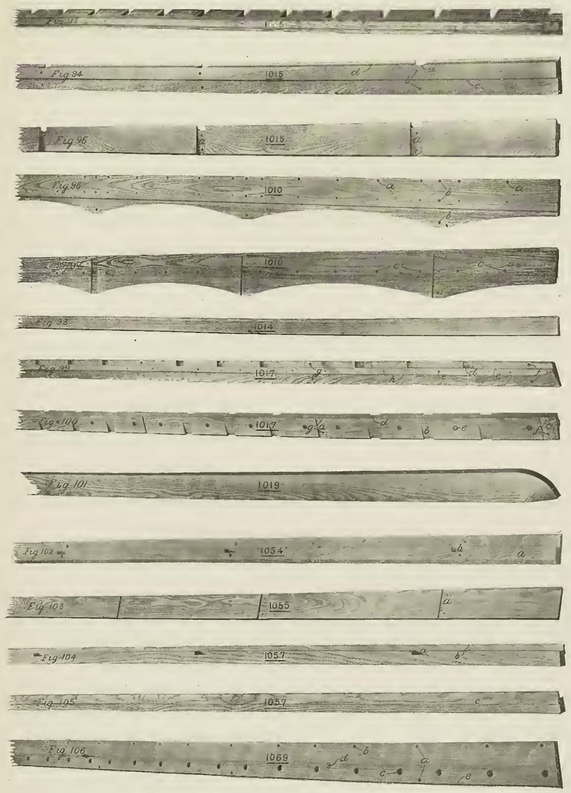
Consecutive Number	Quantity	Name of Piece	Piece Number Plates II. and VI.	Material See Plates I. and II.	Details: Quantity	Details: Name	Details: Reference Letter Plate VI.	Dimensions	Observations and Particulars of How Used	Tools Usually Employed (Others can be used if convenience or necessity requires)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
									The assembling of the pieces composing the ends of an open car is proceeded with independently of the bottom (*see Table No. 32 and Plate IV.*), and only when the end framework or end-bulkhead (6001) as it is termed, is completed, as shown in Fig. 147, is the building up of the car body as a whole proceeded with. The pieces of which the end-bulkheads are composed, and the manner in which they are assembled, are as follows, all joints being well glued:—	
28	4	**End center-posts** (Figs. 170, 171)	6005	A.	--	----------	--	6 ft. 11⅝ in. x 3⅝ x 1⅛ in.	Each having:—	
					1	Tenon	a	2¼ in. x 1½ in. x ⅞ in.	To tenon into mortise (b) of bottom false-sill (6011), Fig. 161	Double end tenoner and gainer
					1	Gain	b	5¼ in. x 1½ in. x ½ in.	For outside end-bottom-rail (6010), Fig. 160, to gain into	Double end tenoner and gainer
					1	Gain	c	5¼ in. x 1½ in. x ½ in.	For inside end-bottom-rail (6009), Fig. 159, to gain into	Double end tenoner and gainer
					1	Gain	d	2⅝ in. x 1½ in. x 13 16 in.	For outside end-belt-rail (6008), Fig. 158, to gain into	Double end tenoner and gainer
					1	Gain	e	2 13 16 in. x 1½ in. x ⅛ in.	For inside end-belt-rail (6007), Fig. 157, to gain into	Double end tenoner and gainer
					1	Gain	f	3½ in. x 1½ in. x ½ in.	For end sub-top-rail (6012), Fig. 162, to gain into	Double end tenoner and gainer
					1	Tenon	g	2⅜ in. x 1½ in. x ½ in.	To tenon into mortise (b) on underside of end top-rail (6006), Fig. 150	Double end tenoner and gainer
					2	Bolt-holes	h	⅜ in. diam.	For bolts to secure the end-post strap-bolts (6509), Fig. 191	Borer or multiple spindle drill
					2	Rabbets	i	5-16 in. deep	Running down the post from the gain (f) to the bottom, for the window-sashes to slide in, leaving beads (j) on the outside, called the outside window-stop. To complete the grooves in which the 6 end-sashes slide, there are in all:—	Planer
29	12	**Post parting-strips** (Fig. 175)	6024	A.	--	----------	--	2 ft. 9 15-16 x ⅞ & ¾ x 5-16 in.	Also shown at (k), Fig. 171, screwed to the different end-posts with 60 No. 7 x ¾ in. bronze screws	
30	4	**False end-posts** (Figs. 172, 173)	6004	A.	--	----------	--	6 ft. 5⅞ in. x 3⅝ in. x 1⅛ in.	Each having:—	
					1	Tenon	a	2 in. x 1⅜ in. x ⅞ in.	To tenon into mortise (d) of bottom false-sill (6011), Fig. 161	Double end tenoner and gainer
					1	Gain	b	5¼ in. x 1⅛ in. x ½ in.	For outside end-bottom-rail (6010), Fig. 160, to gain into	Double end tenoner and gainer
					1	Gain	c	5¼ in. x 1⅛ in. x ½ in.	For inside end-bottom-rail (6009), Fig. 159, to gain into	Double end tenoner and gainer
					1	Gain	d	2⅝ in. x 1⅛ in. x 13-16 in.	For outside end-belt-rail (6008), Fig. 158, to gain into	Double end tenoner and gainer
					1	Gain	e	2 13-16 in. x 1⅛ in. x ⅛ in.	For inside end-belt-rail (6007), Fig 157, to gain into	Double end tenoner and gainer
					1	Gain	f	3½ in. x 1⅛ in. x ½ in.	For end sub-top rail (6012), Fig. 162, to gain into	Double end tenoner and gainer
					1	Tenon	g	2⅜ in. x 1⅛ in. x ½ in.	To tenon into mortise (c) on under side of end-top-rail (6006), Fig. 150	Double end tenoner and gainer
					1	Rabbet	h	5-16 in. deep	Running down the post from the gain (f) to the bottom, for the window-sash to slide in, leaving a bead (i) on the outside, called the outside window-stop. Post parting-strips (6024), Fig. 175, also shown at (j) are screwed to the posts to complete the grooves in which the end-sashes slide. (*See Con. No. 29*)	Planer
					1	Rabbet	--	2 ft. 8¾ in. x ½ in. x 5-16 in.	Running from gain (f) to gain (d) on the other side of the post, for the bulkhead-panel (9043) to fit in	Planer
31	2	**End top-rails** (Figs. 150, 151, 152)	6006	A.	--	----------	--	6 ft. 11¾ in. x 4⅛ in. x 1¾ in.	In two pieces, spliced, glued and screwed together with 16 No. 14 x 1½ in. steel screws, each one having:—	
					2	Tenon	a	3½ in. x 2⅜ in. x ⅞ in.	To fit into mortises (b) of corner-posts (6002), Figs. 148, 149	Double end tenoner
					2	Mortises	b	2⅜ in. x 1½ in. x ½ in.	On underside, to receive tenons (g) of end center-posts (6005) with ¼ in. holes for wood pins	Hollow chisel mortiser
					2	Mortises	c	2⅜ in. x 1⅛ in. x ½ in.	On underside, to receive tenons (g) of false end-posts (6004) with ¼ in. holes for wood pins	Hollow chisel mortiser
					1	Mortise	d	1½ in. x 2 in. x ½ in.	On upperside, to receive tenon of ventilator end-center-post (7006) with ¼ in. hole for wood pin	Hollow chisel mortiser
					2	Mortises	e	2 in. x 1⅞ in. x ½ in.	On upperside, to receive tenons of ventilator end-corner-posts (7004) with ¼ in. holes for wood pins	Hollow chisel mortiser
					2	Rabbets	f	2 3-16 in. x 1 in. x 3-16 in.	For end top-rail tie-plates (6504), Fig. 176	Hollow chisel mortiser
					2	Rabbets	g	1 ft. 8½ in. x ½ in. x 5-16 in	To receive the ventilator end-sign-sashes (9017)	Shaper
32	2	**Bottom false-sills** (Fig. 161)	6011	A.	--	----------	--	6 ft. 2¼ in. x 3⅝ in. x 1¼ in.	Each having:—	
					2	Tenons	a	¾ in. x ¾ in. x 1¼ in.	To tenon into mortises (g) of the corner-posts (6002), Figs. 148, 149	Double end tenoner
					2	Mortises	b	1½ in. x ⅞ in. x 1¼ in.	To receive tenons (a) of end center-posts (6005) with ¼ in. holes for wood pins	Hollow chisel mortiser
					2	Bolt-holes	c	½ in. diam.	For end center-post strap-bolts (6509), Fig. 191	Borer or multiple spindle drill
					2	Mortises	d	1⅛ in. x ⅞ in. x 1¼ in.	To receive tenons (a) of false end-posts (6004)	Hollow chisel mortiser
									The tenons of the end-posts are inserted in their respective mortises in the end top-rail and bottom false-sill, and after being squared the end center-posts are draw-pinned	
33	2	**Inside end-belt-rails** (Fig. 157)	6007	A.	--	----------	--	6 ft. 10½ in. x 2⅞ in. x ¾ in.	Each having:—	
					2	Tenons	a	1¾ in. x ⅜ in. x 2⅞ in.	One at each end (not seen in the figure) to fit into mortises (e) in corner-posts (6002)	Double end tenoner and gainer
					2	Gains	b	1½ in. x ¼ in. x 2⅞ in.	To interlock with gains (e) of the end center-posts (6005) to which they are screwed with 8 No. 12 x 1¼ in. bronze screws.	Double end tenoner and gainer
					2	Gains	c	1⅛ in. x ¼ in. x 2⅞ in.	To interlock with gains (e) of the false end-posts (6004) to which they are screwed with 8 No. 12 x ¼ in. bronze screws.	Double end tenoner and gainer
34	2	**Inside end-bottom-rails** (Fig. 159)	6009	A.	--	----------	--	6 ft. 7⅜ in. x 5¼ in. x ¾ in.	Same as outside end-bottom-rails, Fig. 160, each having:—	
					2	Tenons	a	1¾ in. x ⅜ in. x 5¼ in.	One at each end, to fit into mortises (c) in corner-posts (6002)	Double end tenoner and gainer
					2	Gains	b	1½ in. x ¼ in. x 5¼ in.	To interlock with gains (c) of the end center-posts, to which they are screwed with 8 No. 12 x 1¼ in. bronze screws	Double end tenoner and gainer
					2	Gains	c	1⅛ in. x ¼ in. x 5¼ in.	To interlock with gains (c) of the false end-posts, to which they are screwed with 8 No. 12 x 1¼ in. bronze screws	Double end tenoner and gainer
35	2	**Outside end-belt-rails** (Fig. 158)	6008	A.	--	----------	--	6 ft. 10½ in. x 2⅞ in. x 1⅛ in.	Each having:—	
					2	Tenons	a	1¾ in. x ½ in. x 2⅝ in.	To fit into mortises (d) in corner-posts (6002)	Double end tenoner and gainer
					2	Gains	b	⅞ in. x ¼ in. x 2⅝ in.	To interlock with gains (d) of the end center-posts, to which they are screwed with 8 No. 12 x 1¼ in bronze screws	Double end tenoner and gainer
					2	Gains	c	13-16 in. x ¼ in. x 2⅝ in.	To interlock with gains (a) of the false end-posts, to which they are screwed with 8 No. 12 x 1¼ in. bronze screws	Double end tenoner and gainer
					1	Rabbet	d	⅞ in. x ¼ in.	Full length for the window-sashes to rest on	Molding machine

BOSTON CLOSED CAR. (Table No. 33.)

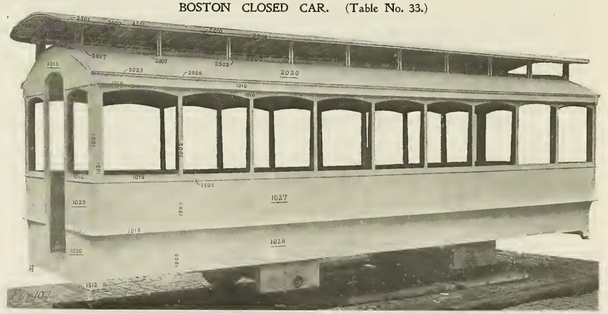


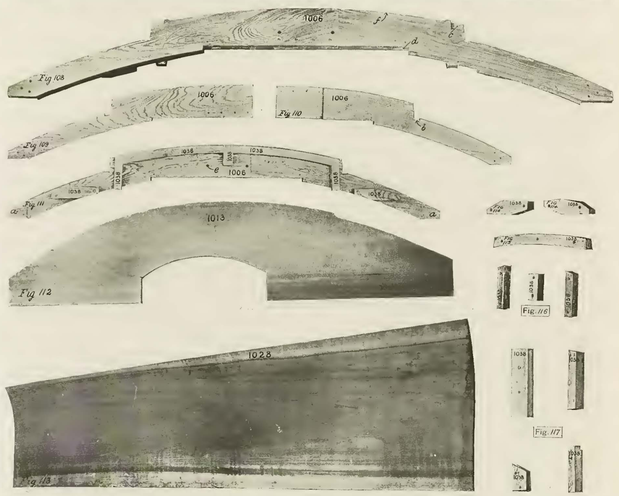


BOSTON CLOSED CAR. (Table No. 33.)



BOSTON CLOSED CAR. (Table No. 33.)





BOSTON CLOSED CAR. (Table No. 33.)

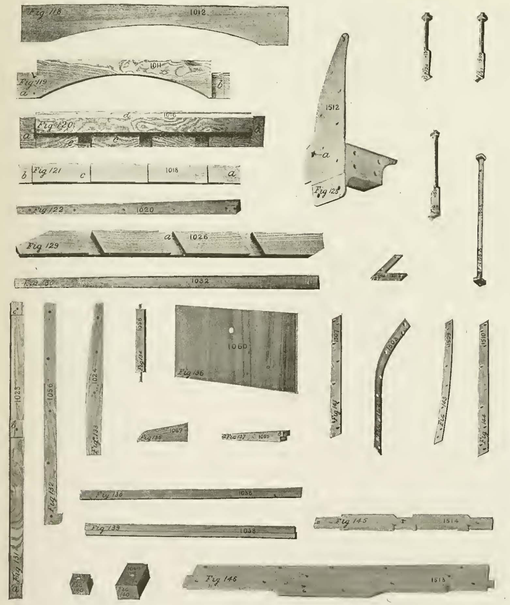


PLATE V. [Figs. 75 to 146]

DETAILS OF SIDES AND ENDS (BODY) OF

BOSTON CLOSED STANDARD CAR

ILLUSTRATING

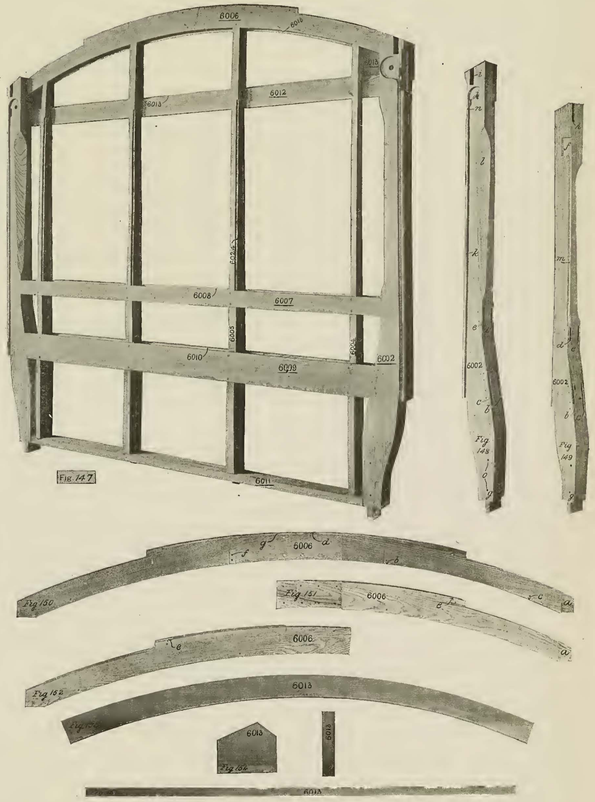
STREET CAR BUILDING

(Stephenson Practice)

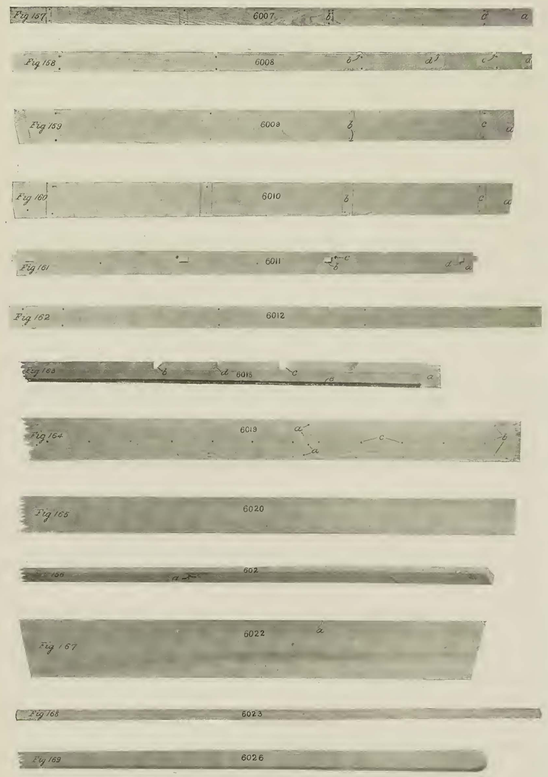
By

Charles Henry Davis, C. E.

BROOKLYN OPEN CAR. (Table No. 34.)



BROOKLYN OPEN CAR. (Table No. 34.)



BROOKLYN OPEN CAR. (Table No. 34.)

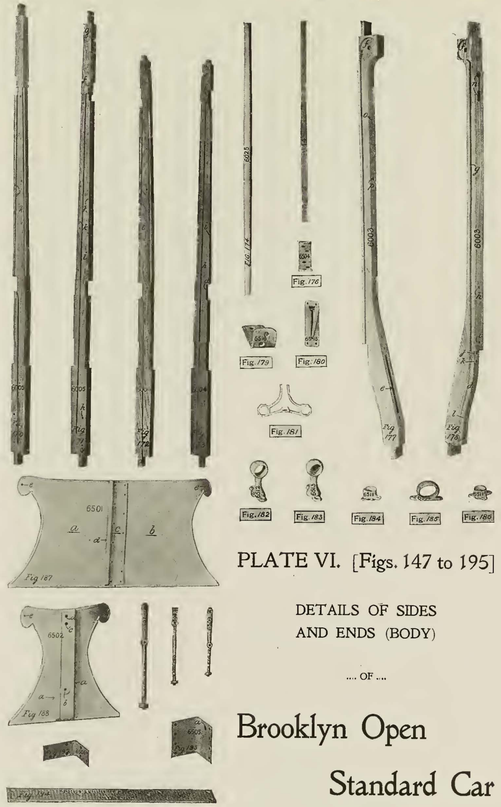


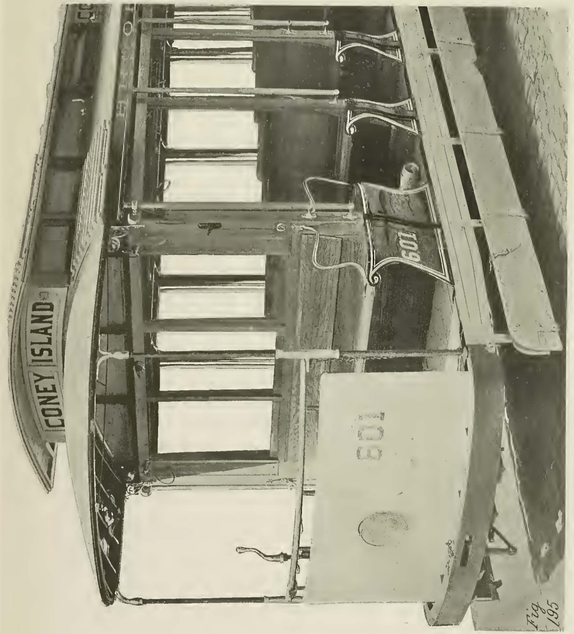
PLATE VI. [Figs. 147 to 195]

DETAILS OF SIDES AND ENDS (BODY)

.... OF ....

Brooklyn Open Standard Car

BROOKLYN OPEN CAR. (Table No. 34.)



ILLUSTRATING

STREET CAR BUILDING

(Stephenson Practice)

By

Charles Henry Davis, C. E.

36	2	**Outside end-bottom-rails** (Fig. 160)	6010	A.	--	----------	--	6 ft. 7⅜ in. x 5¼ in. x ¾ in.	Same as inside end-bottom-rails, Fig. 159, each having :—
					2	Tenons	a	1¾ in. x ⅜ in. x 5¼ in.	To fit into mortises (b) in corner-posts (6002) — Double end tenoner and gainer
					2	Gains	b	1½ in. x ¼ in. x 5¼ in.	To interlock with gains (b) of the end center-posts, to which they are screwed with 8 No. 12 x ¼ in. bronze screws — Double end tenoner and gainer
					2	Gains	c	1⅛ in. x ¼ in. x 5¼ in.	To interlock with gains (b) of the false end-posts, to which they are screwed with 8 No. 12 x 1¼ in. bronze screws — Double end tenoner and gainer
37	2	**End sub-top-rails** (Fig. 162)	6012	A.	--	----------	--	6 ft. 11½ in. x 3½ in. x ½ in.	Each one fitting in gains (f) of the end center-posts, and the gains (f) of the false end-posts, to which they are screwed with 16 No. 12 x 1¼ in. steel screws. They further fit in rabbets (f) of the corner-posts, to which they are also screwed with 8 No. 12 x 1¼ in. steel screws
									The inside portion of the end-bulkhead framework being put together as described, and thoroughly squared, it is completed by the addition of
38	4	**Corner-posts** (Figs. 148, 149)	6002	A.	--	----------	--	6 ft. 5 in. x 4 in. x 3⅝ in.	Each having :—
					1	Tenon	a	2¼ in. x ⅞ in. x 3⅝ in.	To fit into mortise (a) of the side-sill, Plate IV., Fig. 49 — End tenoner
					1	Mortise	b	5¼ in. x 1¾ in. x ⅜ in.	For tenon (a) of the outside end bottom-rail (6010) to fit into — Hollow chisel mortiser
					1	Mortise	c	5¼ in. x 1¾ in. x ⅜ in.	For tenon (a) of the inside end-bottom-rail (6009) to fit into — Hollow chisel mortiser
					1	Mortise	d	2⅝ in. x 1¾ in. x ½ in.	For tenon (a) of the outside end-belt-rail (6008) to fit into — Hollow chisel mortiser
					1	Mortise	e	2⅞ in. x 1¾ in. x ¾ in.	For tenon (a) of the inside end-belt-rail (6007) to fit into — Hollow chisel mortiser
					1	Rabbet	f	3½ in. x 2 in. x ½ in.	For ends of end sub-top-rail (6012) to fit in — Hollow chisel mortiser
					1	Mortise	g	1¼ in. x ¾ in. x ¾ in.	For tenon (a) of the bottom false-sill (6011) to fit into — Hollow chisel mortiser
					1	Mortise	h	3½ in. x 2⅜ in. x ⅞ in.	For tenon (a) of the end top rail (6006) to fit into — Hollow chisel mortiser
					1	Mortise	i	2⅝ in. x 2 in. x ⅞ in.	For tenon (a) of the side top-rail (6018), Fig. 163, to fit into — Hollow chisel mortiser
					1	Pocket	j	3½ in. diam.	For curtain edge to fit in when rolled up; there is a counterbore 13-16 in. diam. in the center to receive the end of the curtain-roller and the roller-sockets. — Borer
					1	Groove	k	½ in. x ½ in.	For the curtain-guides to slide in — Routing machine
					1	Chamfer	l		To take away the sharp edge of the post — Shaper
					1	Rabbet	m	2 ft. 8¾ in. x ½ in. x 5-16 in.	For the bulkhead-panel (9043) to fit in — Planer
					1	Rabbet	n	6⅝ in. x 1⅞ in. x. ⅜ in.	For side sub-top-rail (6019) to fit in — Hollow chisel mortiser
					2	Bolt-holes	o	⅜ in. diam.	For bolts to secure corner-post strap-bolts (6507) — Borer or multiple spindle drill
					1	Pocket	--		(Not seen) at the top on the outside face of the post, similar to pocket (n) of the side-post, seen in Fig. 181, for guard-rail catch-finger (6515), Fig. 178, to fit in
									The tenons of the various end-rails are well glued, then inserted in their corresponding mortises in the corner-posts, and afterward draw-pinned with hickory dowel-pins. To further strengthen the bulkhead
39	4	**End top-rail tie-plates** (Fig. 176)	6504	S. I.	--	----------	--	4⅜ in. x 1 in. x 3-16 in.	Are inserted in rabbets (f) of the end top rail, and screwed to it and to the end center-posts with 16 No. 12 x 1 in. steel screws.
40	2	**End-valance arch pieces** (Fig. 153)	6013	P.	--	----------	--	5 ft. 9 in. x 3½ in. x ⅜ in.	Are now nailed to the end top-rails, end sub-top-rails, corner and end-posts; how they are placed may be judged from the full view of the bulkhead as it now appears, Fig. 147, where the valance pieces make a kind of bead 5-16 in. wide round the three upper end openings of the bulkhead, to secure the glass for the bulkhead valance lights
4	4	**End-valance corner pieces** (Fig. 154)	6013	P.	--	----------	--	9 ft. x 9⅞ in. x ⅜ in.	
4	4	**End-valance upright pieces** (Fig. 155)	6013	P.	--	----------	--	11⅛ in. x 2⅛ in. x ⅜ in.	
2	2	**End-valance bottom pieces** (Fig. 156)	6013	P.	--	----------	--	5 ft. 7¼ in. x 1½ in. x ⅜ in.	
									The end-bulkheads are now erected bodily on the car bottom, the corner-post tenons being driven into the side-sill mortises (a) Plate IV., Fig. 49, after being well white-leaded. The two bottom false-sills (6011) are then screwed to the flooring-boards with 6 No. 14 x 2 in. steel screws, while further stability is secured by
41	4	**Corner-post strap-bolts** (Fig. 189)	6507	W. I.	--	----------	--	15⅜ in. x 9-16 in.	Bolted to the corner-posts through holes (o), Fig. 148, with 8 bolts 4¼ in. x 5-16 in., and inserted in holes (h) in the side-sills, Fig. 49, and tightened up with their nuts
42	4	**End-post strap-bolts** (Fig. 191)	6509	W. I.	--	----------	--	10½ in. x 9-16 in.	Bolted to the end center-posts, through holes (h), Fig 171, with 8 bolts 2⅛ in. x 5-16 in., and inserted in holes (c) of the bottom false-sills (Fig. 161) and the flooring-boards, and tightened up with their nuts
									The assembling of the pieces composing the body now proceeds as follows :—
43	16	**Side-posts** (Figs. 177, 178)	6003	A.	--	----------	--	6 ft. 5 in. x 2¾ in. x 2 in.	Each having :—
					1	Tenon	a	2¼ in. x ⅞ in. x 2¾ in.	To fit into mortises (b) in side-sills, Plate IV., Fig. 49 — Double end tenoner and gainer
					1	Tenon	b	2½ in. x ⅝ in. x 2¾ in.	To fit into mortises on underside of side top-rail (6018), Fig. 163, not seen in the figure — Double end tenoner and gainer
					1	Gain	c	6 in. x ⅜ in.	For side sub-top-rail (6019) to fit in — Double end tenoner and gainer
					2	Rabbets	d	½ in. x ½ in x 1 ft. 6⅛ in.	To fit side-post seat-end iron-panel (6502), Fig. 188 — Shaper
					1	Mortise	e	10¼ in. x 1 in. x ¾ in.	For seat division-board to fit in — Hollow chisel mortiser
					2	Pockets	f	3½ in. diam.	For curtain edges to fit in when rolled up; there is a counterbore 13-16 in. diam. in the center to receive the ends of the curtain-roller and the roller-sockets — Borer
					2	Grooves	g	½ in. x ½ in.	For the curtain-guides to slide in — Routing machine
					1	Bolt-hole	h	7-16 in. diam.	For reversible seat-back arm-pivot (9505) to hold pillar-handle middle-socket (6512) and reversible seat-back arm (9503) — Borer or multiple spindle drill
					1	Bolt-hole	i	⅜ in. diam.	For bolt to hold pillar-handle bottom-socket (6513) — Borer or multiple spindle drill
					1	Bolt-hole	j	7-16 in. diam.	For bolt to secure side-post seat-end iron-panel (6502) to side-post — Borer or multiple spindle drill
					1	Bolt-hole	k	½ in. diam.	For side-post tie-rod (6510) — Borer or multiple spindle drill
					1	Bolt-hole	l	7-16 in. diam.	For bolt to secure side-post seat-end iron-panel (6502) to side-post — Borer or multiple spindle drill
					1	Bolt-hole	m	⅜ in. diam.	For bolt to secure side-post strap-bolt (6508) to side-post, with counterbore ½ in. deep for the bolt head. — Borer or multiple spindle drill
					1	Pocket	n		For guard-rail catch-finger (6515) to fit in, it is only in the third side-post from each end, making 4 in all — Borer and hollow chisel mortiser
					2	Grooves	o	⅛ in. x ⅛ in. x 20 in.	For wires to electric push-button (8616) — Circular saw
					1	Pocket	p	⅝ in. diam. x 7-16 in. deep	For electric push-button (8616) — Borer
									The mortises (b) in the side-sills, Fig. 49, being white-leaded, the side-posts are driven in and secured with
44	16	**Side-post strap-bolts** (Fig. 190)	6508	W. I.	--	----------	--	11 3-16 in. x 7-16 in.	Bolted and screwed to side-posts through holes (m), Fig. 181, with 16 bolts 3¼ in. x 5-16 in. and 16 No. 10 x 1¼ in. steel screws; they are inserted in holes (i) of the side sills, Plate IV., Fig. 49, and tightened up with their nuts
45	2	**Side top-rails** (Fig. 163)	6018	Y. P.	--	----------	--	26 ft. 0 in. x 3 in. x 2¼ in.	Each having :—
					2	Tenons	a	2⅝ in. x 2 in. x ⅞ in.	To fit in mortises (i) of the corner-posts (6002) — Double end tenoner and gainer
					8	Mortises	--	2½ in. x ⅝ in. x 2¾ in.	To receive tenons (a) of the side-posts (6003); they are on the underside of the rail and not seen in the figure
					8	Gains	b	1⅞ in. x ⅞ in.	For lower-deck compound-carlines (7010) — Double end tenoner and gainer
					2	Gains	c	1⅞ in. x ⅞ in.	For lower-deck thick-rafters (7011); these are next the corner-posts — Double end tenoner and gainer
					18	Gains	d	13-16 in. x ⅞ in.	For lower-deck thin-rafters (7012) — Double end tenoner and gainer
					1	Rabbet	e	⅝ in. x ⅜ in.	Running the whole length for side sub-top-rail (6019) to fit in — Molding machine
									These rails are adjusted to the corner and side-posts, and secured with 4 No. 16 x 3 in. steel screws to the former, and with hickory dowel-pins to the latter
46	2	**Side sub-top-rails** (Fig. 164)	6019	A.	--	----------	--	25 ft. 11⅜ in. x 6⅝ in. x ¾ in.	Screwed to side-posts through holes (a) with 64 No. 12 x 1 in. steel screws, and to corner posts through holes (b) with 12 No. 12 x 1 in. steel screws
47	2	**Side top-panels** (Fig. 165)	6020	P.	--	----------	--	26 ft. 4 in. x 5 11-16 in. x ⅜ in.	Nailed to side sub-top-rail (6019)
48	2	**Drip-rails** (Fig. 166)	6021	A.	--	----------	--	26 ft. 3¼ in. x 3½ in. x 1½ in.	Each having :—
					10	Pockets	a	1¼ in. diam.	For pillar-handle top-sockets to fit in; the drip-rails are secured to the side sub-top-rails (6019) by 98 No. 12 x 12 in. steel screws, screwed through holes (c) in the latter and through the side top-panels into the drip-rail — Borer
49	8	**Seat division-boards** (Fig. 167)	6022	P.	--	----------	--	6 ft. 8½ in. x 10⅛ in. x 1 in.	Adjusted to side-posts, and fitted in the mortises (e) of the side-posts (6003)

TABLE NO. 34—*Continued*

Consecutive Number	Quantity	Name of Piece	Piece Number Plates II. and VI.	Material See Plates I. and II.	Details: Quantity	Details: Name	Details: Reference Letter Plate VI.	Dimensions	Observations and Particulars of How Used	Tools Usually Employed (Others can be used if convenience or necessity requires)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
					1	Groove	a	½ in. x ½ in.	Runs along the top edge for the side-post tie rod to lie in	Molding machine
50	8	**Foot-rail brackets** (Fig. 181)	6503	C. I.	--	----------	--		Bolted to the bottom of the seat division-boards, in their centre (6022), with 8 bolts 2¼ in. x ⅜ in., to hold the foot-rails	
51	16	**Foot-rails** (Fig. 168)	6023	A.	--	----------	--	6 ft 7⅜" x 1½" octagonal	Inserted in the foot-rail brackets (6503); they are adjusted later. (*See Con. No. 53*)	
52	4	**Corner-post seat-end iron-panels*** (Fig. 187)	6501	M. I.	--	----------	--		In 2 pairs, each consisting of 3 pieces, shown and marked in the figures (a), (b) and (c), (b) being the piece next the front or platform, and (a) the piece toward the center of the car. The two pieces (a) and (b) are screwed to the corner-posts with 52 No. 14 x 1½ in. steel screws, the holes for the screws being under the covering piece (c), and fastened to the side-sills through tongues at the bottom on the other side of the panels with 24 lag screws 2 in. x ⅜ in., after which the covering pieces (c) are screwed to the corner-posts with 52 round-head, blued-steel screws No. 16 x 1½ in. There are in each:—	
					1	Groove	d	½ in. x ½ in.	In the covering piece (c) for the curtain-guides to slide in	
					1	Hole	e	⅜ in. diam.	In each panel piece (a) and (b) for seat bolt (9507)	
53	16	**Side-post seat-end iron-panel*** (Fig. 188)	6502	M. I.	--	----------	--		Each having:—	
					2	Grooves	a	½ in. x ½ in.	For the curtain-guides to slide in	
					1	Hole	h	⅜ in. square	For bolt 4⅜ in. long through side post, with round-head on the outside	
					1	Hole	c	½ in. diam.	For side-post tie-rod (6510)	
					1	Hole	d	⅜ in. square	For bolt 3¾ in. long through side-post, with countersunk-head on the inside.	
					2	Holes	e	⅜ in. diam.	For seat-bolt (9507)	
					4	Tongues	--		At the bottom on the inside (not seen) with holes in them for 64 lag screws, 2 in. x ⅜ in., to fasten the panels to the side-sills	
					2	Sockets	--		(Not seen) cast on the inside of the panels, corresponding to the foot-rail brackets (6503), Fig. 181, into which the round ends of the foot-rails are inserted, so that when the panels are fixed and tightened up, the foot rails are held securely in place. (*See Con. No. 51*)	
54	8	**Side-post tie-rods** (Not Ill.)	6510	W. I.	--	----------	--	7 ft. 3¾ in. x 7-16 in.	Are passed through hole (c) of the side-panel and side-post to and through the opposite side-post and side-panel, and tightened up with a nut at each end	
55	4	**Top-panel corner-plates** (Fig. 193)	6505	S. I.	--	----------	--	4¼ in. x 4¼ in. x 3¼ x 1-16 in.	Screwed to corner-posts, side and end top-panels with 32 No. 10 x 1 in. steel screws. Each one has	
					1	Hole	a	½ in. diam.	For platform-hood bracket (7505) bolt	Punch
56	4	**Sub-top-rail corner-plates** (Fig. 192)	6506	S. I.	--	----------	--	3 11-16" x 3 5-16" x 1¾" x 1-16"	Screwed to corner-posts, side and end sub-top-rails with 8 No. 10 x 1 in. and 24 No. 7 x ¾ in. steel screws	
57	4	**Side-sill wear-plates** (Fig. 194)	5507	M. I.	--	----------	--	18 in. x 2⅛ in. x 3-16 in.	Screwed to side-sills between the seat-end panels and in front of the corner-post panels with 132 No. 12 x 1 in. steel screws	
4	4	**Side-sill wear-plates** (Fig. 194)	5507	M. I.	--	----------	--	17 in. x 2⅛ in. x 3-16 in.		
14	14	**Side-sill wear-plates** (Fig. 194)	5507	M. I.	--	----------	--	14 in. x 2⅛ in. x 3-16 in.		
58	16	**Pillar-handle top-sockets** (Fig. 186)	6511	Bz.	--	----------	--		With 3 ears, and	
	4	**Pillar-handle top-sockets** (Fig. 184)	6511	Bz.	--	----------	--		With 2 ears, fitted to cavities (a) in the drip-rails (6021) and secured with 56 No. 9 x ¾ in. bronze screws; the 4 sockets with 2 ears being for the cavities at each end of the drip-rails	
59	12	**Pillar-handle middle-sockets** (Fig. 182)	6512	Bz.	--	----------	--		Screwed to corner-posts and the second and fourth side-posts from each end, with 12 No. 12 x 1¼ in. bronze screws, and further secured with the seat-back arm-pivots (9505) going through holes (h) in the side-posts, Fig. 181, (*see Con. No. 43*) and to the corner-posts with 4 bolts 4⅝ in. x 5-16 in. with round beveled heads on the inside and bronze nuts on the outside	
60	2	**Guard-rails** (Fig. 169)	6026	A.	--	----------	--	27 ft. 0 in. x 2¾ in. x 1¼ in.	Are laid on the pillar-handle middle-sockets, between the side-posts and the pillar-handles, to which	
61	4	**Guard-rail guides** (Fig. 185)	6514	Bz.	--	----------	--		Have been previously screwed with 8 No. 12 x 1 in. bronze screws, one at each end of the guard-rails	
62	20	**Pillar-handles** (Fig. 174)	6025	A.	--	----------	--	4 ft. 0¾ in. x 1½ in. diam.	Are now passed through the pillar-handle middle-sockets, the guard-rail guides, and their top tapered ends fitted in the pillar-handle top-sockets, and secured in this position by their bottom ends being fitted in	
63	20	**Pillar-handle bottom-sockets** (Fig. 183)	6513	Bz.	--	----------	--		Which are screwed to the corner-posts with 4 No. 12 x 1¼ in. and 4 No. 18 x 1¾ in. bronze screws, and to the side-posts with 16 No. 12 x 1¼ in. bronze screws, and further secured to the side-posts with 16 bolts 3¾ in. x 5-16 in. with round beveled heads and bronze nuts, passing through holes (i) in the side-posts, Fig. 181. (*See Con. No. 43*)	
64	8	**Guard-rail catches** (Fig. 180)	6515	M. I.	--	----------	--		Screwed to the top of corner-posts and each third side-post from the end, over pockets (n), Fig. 181 (*see Con. Nos 38, 43*), with 32 No. 8 x ⅝ in. steel screws. When entrance to the seats is desired, the guard-rail is pushed up past the spring-finger, which then springing forward holds the rail secure; and when entrance to the seats is to be closed, the rail is lowered to rest on the pillar-handle middle-sockets	
65	8	**Guard-rail wear-plates** (Fig. 179)	6516	Bz.	--	----------	--	2½ in. x 1¼ in. x 1 in. x 1-16 in.	Are screwed to the guard-rail, with 16 No. 9 x ½ in. and 16 No. 7 x ½ in. bronze screws, where the rail rests on the top catch (6515)	
									The car body is now ready to receive the roof, which is described in Table 36 and illustrated by Plate VIII.	

Number of Distinctive Pieces	38	(Column 1)
Total Number of Pieces	286	(" 2)
Number of Bolts	92	(" 6 and 10)
Number of Screws, about	942	(" 6 and 10)
Number of Nails	(?)	
Total	1320 +	

* These are J. G. Brill Co.'s make.

LEGAL NOTES AND COMMENTS

EDITED BY J. ASPINWALL HODGE, JR., OF THE NEW YORK BAR*

Some Recent Decisions

STOCKHOLDERS' LIABILITY

In two cases just decided by the Supreme Court of the United States, a much mooted question upon which courts have differed, has been decided, and perhaps in a way which is binding upon the courts of all the States.

Each State in the Union has a different set of provisions in its statutes, and some times in its constitution, creating, restricting, and defining the liability of stockholders of an insolvent corporation for its debts. In some States, as in West Virginia, this liability is so restricted as to be almost obliterated, while in other States, *e. g.*, Kansas, the conditions which create the liability are numerous.

The highest courts in many of the leading States have frequently refused to enforce a stockholder's liability against their own citizens when it was claimed that such a liability arose out of the statutes of another State in which the corporation was organized.

This policy has been ably defended, and has been as ably criticised. It would seem that the decisions in the two cases referred to, (*Whitman vs. the Bank, advance sheets S., P. 506*), especially the latter, will compel a reversal of this policy, for the court holds that when the laws of a State in which a judgment is rendered against a corporation organized in that State provide that it shall be binding on the stockholders, the courts of every other State must give that judgment the same conclusive effect against a stockholder, who is sued, as if he had been a party to the action in which the judgment was obtained, and the only defenses which the stockholder can make are those which he is allowed to interpose in the courts of the State in which the judgment against the corporation was rendered. This would seem to overthrow the rule in such cases as *Marshall vs. Sherman, 148 N. Y., 79.*

X-RAYS

A novel scientific question has been raised in a recent case where an application was made to require a plaintiff in an action for personal injuries, to submit his neck to the action of the X-rays, in order that the nature and extent of his injuries might be ascertained. It would seem that where an examination of the person is allowed by the court, that certain mechanical devices may be used by the physician, as for example, a measuring tape, a magnifying glass, the stethescope, or the various devices used to throw light into the mouth, the eye, etc., but the court was up against a new question when it was asked to compel the plaintiff to allow the physician to use the X-rays. It was insisted, in support of the particular application made, that the court should take judicial notice of the fact that exposure to X-rays is not injurious to the subject. While denying the application on other grounds, the court expressed a doubt as to whether science is sufficiently far advanced to justify the court in taking judicial notice of the claimed harmlessness of the action of the ray. It was held that the application was not seasonably made, and that it was affirmatively shown that the person who was to apply the ray had sufficient knowledge and experience to apply it properly.

DAMAGES CAUSED BY DELAY

A case recently decided in England is of interest to the common carrier and the traveling public. An English barrister sued the Metropolitan Underground Road for the inconvenience, loss of time and necessary expenditure in cab hire arising out of the fact that after the defendant's railway line had become blocked, the company sold him a ticket and allowed him to board a train, which, after running a short distance, was stalled. The court held that he had stated a cause of action, although it was obliged to deny him relief on the ground that he failed to prove that sufficient time had elapsed between the happening of the accident which caused the block down the line and the time when he purchased the ticket and his train was despatched.

Apparently, the court held that it was the duty of the common carrier to have proper telegraphic facilities, and having these, to notify the stations along the line of a blockade and to refrain from selling tickets or despatching trains which would only tend to delay its passengers.

STREET RAILWAYS AND STREET ASSESSMENTS

The street railway companies are liable for assessments along with the abutting property owners for the cost of street improvements is a proposition recently reiterated in the case of *Shreveport vs. Prescott, 55 La. Ann., 1895.* This is in accordance with what appears to be the preponderance of authority. But the liability of the street railway company for anything above the nominal amount which may be assessed for actual benefits conferred upon the company by the improvement is generally determined by the presence or absence of provisions in the franchise or contract under which it obtains the right to occupy a portion of the street, creating a contractual liability.

It was held in *Norwood vs. Baker, 172 U. S., 269,* by the Supreme Court of the United States that any assessment upon a property owner for improvements which are not limited to the benefits conferred by the improvement upon the property was in violation of the constitution of the United States. This, of course, does not affect the provisions of a franchise which compels the railway company to pay for street improvements over and above the benefit they may confer upon the property of the company, but in the absence of such provision it limits the possible assessment to the actual benefit derived.

It is manifest that the ordinary street improvement, such as paving or curbing the street does not confer any great benefit upon a street car line which may be operating in its center.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

NEW YORK.—Motive Power—Change—Abutting Property—Required Consent—Commission—Substituted Consent.

Under Laws 1890, chap. 565, sec. 100, providing that any change in the motive powers of a street railway must be consented to by the owners of one-half the abutting property, and in case such consent could not be obtained the determination of a commission appointed by the general term of the Supreme Court in favor of such motive power, when confirmed by the court, should be taken in lieu thereof, and that such consent should be obtained in the same manner as provided in sections 91 and 94 of the same act, which sections require that for the construction of a street railway the consent of the owners of one-half "in value" of the abutting property should be obtained, etc., a petition for a commission to authorize a change of motive power, alleging that the consent of the owners of one-half "in value" of the required property could not be obtained, was not insufficient because it did not show that the consent of the owners of one-half the "lineal front feet" of such property could not be obtained, since the evident intent of the Legislature was to conform the practice of obtaining the consent to a change in motive power to that required for the construction of a street railway.—(In re Rochester & L. O. Ry. Co., 64 N. Y., Suppl., 429.)

NEW YORK.—Pleading—Amendments—Misnomer of Defendant.

1. Under Code Civ. Proc., section 723, permitting amendments to pleadings upon the trial, or at any stage of an action before judgment, by adding or striking out the name of a party, or by correcting a mistake in the name of the party, plaintiff may be allowed to amend his complaint by correcting a mistake in the

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name of a corporation defendant after appearance, and before trial.

Same—Waiver of Misnomer.

2. Under Code Civ. Proc., section 1777, providing that a mistake in the corporate name of a party to an action is waived unless the misnomer is pleaded in the answer, or other pleading in defendant's behalf, a defendant who has waived sueh mistake by failure to plead it cannot complain of the allowance of an amendment to the complaint correcting a mistake in the name of a corporation defendant.

Courts—Jurisdiction—Domestic Corporations.

3. The operation of a railway by a corporation within the territorial jurisdiction of the municipal court of the city of New York is sufficient to constitute a residence by such corporation within the jurisdiction of said court, under Code Civ. Proc., section 341, giving the County Courts jurisdiction of actions against domestic corporations actually located within the county.

Appeal—Issues in Lower Court—Estoppel.

4. Where the cause was voluntarily litigated in the court below upon the theory that two city ordinances of different years, and affecting the rights of defendant, were identical, the plaintiff will not be permitted to claim on appeal that the question of their identity was not properly raised in the court below because one of the ordinances was not introduced in evidenee.

Street Railroads—Times for Running Cars—Construction of City Ordinances.

5. Rev. Ord. City of New York, 1897, sections 595, 596, requiring city railroad companies "not running cars" on the surface of the streets of said eity to run not less than one car every twenty minutes between the hours of 12 midnight and 6 o'clock a. m., under penalty of $100 for every neglect or refusal to comply with the ordinance, are applicable to a street railroad which did not begin to operate its cars, nor have any corporate existence, until the year 1892; said sections being identical with an ordinance of said city adopted in 1890, before said corporation was "running cars," and Rev. Ord., section 785, providing that, in so far as the revised ordinances are subtantially the same as the ordinances existing at the time the former took effect, they shall be construed as a continuance of such ordinances, and not as new ordinances.

Appeal—Questions Not Raised Below.

6. The claim that Rev. Ord. City of New York, sections 595, 596, in regard to the running of street cars after midnight, do not apply to defendant, in the absence of proof that it ran cars or had tracks laid at the time when the revised ordinances took effect, cannot be made on appeal, when such point was not raised in the court below.

Ordinanee Fixing Time for Running Cars—Violation—Evidence.

7. In an action to collect a penalty of a street railway company for its neglect to run cars every twenty minutes after midnight, as required by Rev. Ord. City of New York, sections, 595, 596, evidence that in 1892, by a consolidation of certain street railroads, defendant became the owner of the road, tracks, etc., on W. avenue; that during the daytime of the period in question cars bearing defendant's name were run along said avenue, and that no ears except those bearing the name of defendant were operated thereon; and that on a day named in 1898, from half-past 1 until half-past 5 o'clock in the morning no cars passed a poliee offieer, whose beat extended along said avenue, is sufficient to support a judgment for the penalty prescribed for the violation of said ordinance.—(City of New York vs. Union Ry. Co., of city of New York, 64 N. Y. Suppl., 483.)

LIABILITY FOR NEGLIGENCE.

NEW YORK.—Negligence—Extent of Injuries—Evidence.

1. Where plaintiff, an aetress, suing for injuries sustained, testified that on joining her company, some weeks after the accident, she was so ill as to seldom be able to attend rehearsals, and was under a doctor's care all the time; that her manager well knew how ill she was, and that she was finally compelled by sickness to stop work, it was error to exclude testimony of the manager as to what he had observed as to her physical eondition during that period.

Same.

2. Where plaintiff had testified that she was forced to disband her theatrical company through ill health due to injuries sued for, and not because of her incompeteney as an aetress, it was error to exclude the testimony of her manager as to why the company was disbanded.—(Farrell vs. Metropolitan St. Ry. Co., 64 N. Y. Suppl., 709.)

NEW YORK.—Negligenee—Instruetions.

1. In an action for injuries caused by plaintiff's wagon eolliding with a street car while he was driving across defendant's tracks, an instruction that if, just before the accident, the wagon was driven alongside the track and it was turned into the track in front of the car, the verdict must be for the defendant, was properly refused, since the turning into the track might have been far enough in front of the car to have given the gripman ample time to stop the car and prevent the accident.

Same—Special Damages—Allegation—When Necessary.

2. Where injuries for which recovery is sought do not necessarily result from those described in the complaint, they must be alleged as special damages; and an injury to plaintiff's eye could not be recovered for on an allegation of injury to the head and brain, since it did not necessarily result therefrom.—(Geoghegan vs. Third Ave. R. Co., 64 N. Y. Suppl., 630.)

NEW YORK.—Excessive Damages—Personal Injuries.

Plaintiff, a teacher, was injured by the sudden stopping of defendant's street car, on which she was a passenger, the injury being a dislocation of a cartilage in each knee, with other injuries to her body. She expended $1,670 for medical services, and was confined to her bed about ten weeks. At the time of the trial, eighteen months after the accident, she could not go up and down stairs without pain, and, in consequence of her condition, had to give up her position of general superintendent in a school. Held, that a verdict of $15,000 should be set aside as excessive.—(Kraemer vs. Metropolitan St. Ry. Co., 64 N. Y. Suppl., 619.)

NEW YORK.—Malicious Prosecution—Evidence—Judicial Proceedings.

An action for malicious prosecution will not lie against a defendant for having illegally arrested plaintiff without a warrant, and having brought him before a police court, where he is discharged without the filing of a complaint; an essential element of malicious prosecution being a commencement of judicial proceedings.—(Barry vs. Third Ave. R. Co., 64 N. Y. Suppl., 615.)

NEW YORK.—Personal Injuries—Negligence—Evidence.

In an action against a street railroad company for injuries alleged to have been caused by snow or ice thrown by a sweeper used by defendant to clear the snow from its tracks, in the absence of proof that the snow or ice which had caused the injury and which plaintiff said came from the direction of the sweeper, did in fact come from the sweeper, and in the absence of proof that this was the result of negligence which could have been avoided, a verdict for plaintiff eannot be sustained.—(Connor vs. Metropolitan St. Ry. Co., 63 N. Y. Suppl., 509.)

NEW YORK.—Injuries—Negligence—Conflicting Evidence.

1. Where, in an action for personal injuries from being struck by a street car, the evidence, both as to defendant's negligence and plaintiff's contributory negligence, is conflieting, and sufficient to sutain a verdict for either party, a judgment entered on the jury's verdict will not be disturbed on appeal, as not supported by sufficient evidence.

Same—Speed of Car.

2. Where, in an action for injuries for negligent management of a street car, defendant claimed that the car was going but eight miles an hour, and plaintiff had already shown that it took 80 ft. in whieh to stop it, plaintiff's evidence that but 12 ft. would be required in which to stop a properly equipped car going eight miles an hour was admissible.—(McDonald vs. Brooklyn Heights R. Co., 64 N. Y. Suppl., 480.)

NEW YORK.—Accident at Crossing—Contributory Negligence.

Plaintiff, a motorman, in charge of an electric car, when about 750 feet from a railroad crossing, saw a freight train standing on defendant's track about 315 ft. from the crossing. At this time his car was moving at the rate of 12 miles per hour, and continued at that speed until within 125 ft. of the crossing, when he discovered that the train was backing toward the erossing and that there was danger of a eollision. He reversed his power, put on the brake, and thereby reduced the speed, but could not bring his car to a stop before reaehing the erosing, owing to ice on track, and, as a result, it struck the train, and plaintiff was injured. Held, that he was guilty of contributory negligence as a matter of law.—(Einsfield vs. Niagara Junetion Ry. Co., 63 N. Y. Suppl., 563.)

NEW YORK.—Appeal.

Where, in an aetion against a street car company, defense was supported by testimony of two disinterested witnesses, a judgment for plaintiff will not be held against the weight of evidence where, in addition to her own evidence, she was entitled to the benefit of the presumption arising from failure of defendant to produce its motorman and conductor, who saw the act in question, without sufficient explanation of their absence.—(Staib vs. Union Ry. Co. of New York City, 62 N. Y. Suppl., 755.)

NEW YORK.—Appeal—Review—Dismissal of Complaint—Presumption.

1. In reviewing a judgment dismissing a complaint for insufficiency of evidence, all evidence offered by plaintiff must be taken as true.

Accident at Crossing—Evidence of Contributory Negligence.

2. A truckman, seeing an electric car standing about 100 ft. away, drove across the track in front of it, and was struck and injured by it. He had a lantern in front of his truck, throwing the light forward toward the horses. He did not see the car after he started to drive across the street. Held, that the question of his contributory negligence was for the jury.—(Lowry vs. Metropolitan St. Ry. Co., 62 N. Y. Suppl., 743.)

NEW YORK.—Injuries to Wife—Damages—Medical Attendance—Evidence.

1. In an action by a married woman for injuries, where it appears that she is living with her husband, and is not possessed of any private means or engaged in any separate business, evidence of the physician who attended her as to what his services were worth and what he was paid was incompetent.

Same.

2. In an action by a married woman for injuries, it was error to permit a physician to testify to plaintiff's physical condition as he found it two years after the injury, where it appears that the physician who attended her at the time of the injury did not discover the condition subsequently found to exist, and it further appears that she had, since the injury, given birth to two children, and that the condition found to exist on the second examination might have been caused by either of the intervening confinements. —(Sweeney vs. Union Ry. Co., of New York City, 64 N. Y. Suppl., 453.)

NEW YORK.—Appeal and Error—Case on Appeal—Insertion of Evidence.

1. An appeal from an order denying a motion for a new trial on the minutes raises the questions whether the verdict is excessive or contrary to the evidence, and hence, where plaintiff recovered for injuries, he is entitled to have all the evidence showing the extent of the injury, and the time he was disabled thereby, inserted in the case on appeal.

Same—Certificate as to Evidence—Review of Facts.

2. A certificate that a case on appeal contains all the evidence, only has place and effect where it serves as the only notice that review of the facts is sought, and is therefore unnecessary on an appeal from a judgment on a verdict of the jury and from an order denying a new trial, since such an appeal raises the question of the sufficiency of the evidence to sustain the verdict, and notice of the appeal is notice that the facts will be reviewed.—(Gibson vs. Metropolitan St. Ry. Co., 64 N. Y. Suppl., 396.)

NEW YORK.—Attorney's Lien—Attorney and Client—Fees of Attorney—Value of Cause of Action—Compromise.

1. Plaintiff in an action for damages agreed to pay his attorney one-third of any sum for which the cause might be adjusted. A compromise was made between the parties, by defendant paying plaintiff a stated sum, and also agreeing to pay plaintiff's attorney any claim or lien on the cause of action which he might lawfully establish. Held, that the sum paid plaintiff in compromise was conclusive on the defendant as the value of the cause of action, in determining the amount to be paid plaintiff's attorney by defendant, and not such sum as might be established by a continuance of the action.

Same—Calculation of Fee.

2. Where plaintiff's attorney was entitled to one-third of any sum for which the cause might be adjusted, and it was compromised by defendant paying plaintiff $2,600 as a net payment, and agreeing to pay plaintiff's attorney the amount due him under such settlement, the attorney was entitled to a payment equal to one-third of $2,600 only, and not to a payment equal to one-half of $2,600, though, under his original agreement with plaintiff to receive one-third the amount recovered, his fee would be equal to one-half the net amount received by plaintiff.

Attorney's Fees—Stipulation—Summary Proceedings.

3. Code Civ. Proc., Sec. 66, as amended by Laws 1899, provides that an attorney shall have a lien on his client's cause of action, and that the "court upon the petition of the client or attorney may determine and enforce the lien." Held, not to give the court jurisdiction by summary order to enforce a compromise stipulation between plaintiff and defendant whereby defendant agreed to pay any lien which plaintiff's attorneys might establish on plaintiff's cause of action.

Same—Attorney's Lien—Enforcement.

4. Where plaintiff's attorney had a lien on his client's cause of action, and the case was compromised by defendant making plaintiff a cash payment and promising to pay plaintiff's attorney the amount of his lien, which he afterward refused to do, the attorney had the right to proceed to judgment in the action for the protection and enforcement of his lien.—(Pilkington vs. Brooklyn Heights R. Co., 63 N. Y. Suppl., 211.)

NEW YORK.—Attorney and Client—Attorney's Fees—Summary Proceedings.

A summary proceeding will not lie to enforce an agreement whereby a defendant, as part of a compromise, promised to pay the plaintiff's attorney his costs and fee.—(Schriever vs. Brooklyn Heights R. Co., 63 N. Y. Suppl., 217.)

NEW YORK.—Negligence—Driving in Front of Street Car. Where plaintiff saw a street car approaching about 250 ft. away, and drove on the track in front of it for a considerable distance, making no attempt to observe its approach, and his wagon was struck by the car as he was turning off the track, he was guilty of negligence.—(Pechesky vs. Metropolitan St. Ry. Co., 62 N. Y. Suppl., 478.)

NEW YORK.—Infants—Sui Juris—Negligence.

1. A 9-year-old girl testified that on stepping from the curbstone she saw a street car coming toward her; that she looked up because she thought she might get run over if she did not look; that she knew the car was a dangerous thing; that when she saw the car coming she thought she could get across; and that, as she stepped over the first rail, she knew nothing more. Held, that she was sui juris.

2. Evidence—Presumptions. Where a child was injured at a crossing by a street car, and the motorman was not called as a witness, it raises a presumption of his negligence.

3. Injury to Pedestrian. Plaintiff, 9 years old, attempted to cross a street in a well settled portion of a city, at a crosswalk, in front of a car about 127 ft. distant. When the motorman saw her, he brought the car to a standstill within 10 ft. or 15 ft. of the crosswalk where she was struck. Held, that the refusal of an instruction which assumed that there was nothing in the situation to justify her in the belief that the car would be brought under control before it arrived at the walk was proper, as at variance with the evidence.

4. Trial—Instructions. A refusal of a request to charge, where the court had already charged the matters requested so far as they were established by the evidence, was not error.

5. Contributory Negligence. Plaintiff's failure to defer crossing until the car had passed, or to continue to watch the car, did not constitute contributory negligence as a matter of law, but was a question for the jury.—(Hicks vs. Nassau Elec. R. Co., 62 N. Y. Suppl., 597.)

NEW YORK.—Collision—Action for Injuries. Plaintiff could not recover for injuries resulting from his wagon being struck by defendant's cable car, where he saw the car in time to stop his wagon, but miscalculated the distance, and attempted to drive in front of the car.—(Petri vs. Third Ave. R. Co., 62 N. Y. Suppl., 315.)

OREGON.— Pleading — Speed — Regulation — Ordinance — Amendment—Evidence.

1. Where a complaint to recover for the death of a minor child alleged that defendant was operating its street car at a dangerous and reckless rate of speed, there was no abuse of discretion in allowing an amendment that such a rate of speed was in excess of that permitted by a city ordinance.

2. Evidence of particular instances in which street railway cars were operated at a given speed is not admissible to show the speed of a car at the time of a collision with a child.—(Wade vs. City & Suburban Ry. Co., 59 Pac. Rep., 875.)

PENNSYLVANIA.—Collision With Vehicle—Contributory Negligence.

1. A driver on a narrow street, only 20 ft. wide from curb to curb, on which there were two tracks of an electric street railway, was overtaken by a car going in the same direction as he was driving. He turned onto the other track, driving along it up a hill. When the car approaching him from behind was beside his wagon, another car came suddenly into view from the other side of the hill, in front of him on the track on which he was driving, and ran into him. Held, that the driver was not guilty of contributory negligence, as a matter of law, in not stopping and waiting until the first car had passed him, and then returning to the track which he had left.

2. By the necessity of turning out of the track, the driver was suddenly placed, without fault on his part, in a position of danger; and, in his effort to extricate himself, he could not be held to the use of the best judgment.—(Cannon vs. Pittsburg & B. Traction Co., 44 Atl. Rep., 1089.)

PENNSYLVANIA.—Injury to Boy—Negligence—Briefs—History of Case.

1. Nothing should be stated in the history of the case not justified by the evidence.

2. The motorman, on discovering a boy on the step of the platform, should stop, and take him inside, or put him off; and his negligence in not doing so, intensified by his knocking on the window and kicking on the closed side, manifestly frightened the boy.

PENNSYLVANIA.—Collisions—Negligence. Where the speed of a street car is not unreasonable, and the motorman spares no effort to check it, so as to avoid collision with a person, who,

while proceeding near the track, suddenly attempts to cross ahead of the car, the company is not negligent.—(Sauers vs. Union Traction Co., 44 Atl. Rep., 917.)

PENNSYLVANIA.—Tipping Over Post—Negligence—Evidence—Instruction—Damages—Pain.

1. The question of negligence, where the trolley of a car left its wire, struck a span wire between two posts, and pulled one of them down on plaintiff, is for the jury, it depending on whether there was a useless and abandoned wire forming a loop on the span wire, in which the trolley caught, though only one person, who was not a dull or unveracious witness, testified to its presence, while the superintendent and several of the employees of the company testified that the loop was not there at the time of the accident.

2. An instruction authorizing an allowance in damages for pain and suffering, by way of compensation, is not error; there being no suggestion that pain and suffering had a positive price or market value.—(Bamford vs. Pittsburgh & B. Traction Co., 44 Atl. Rep., 1068.)

PENNSYLVANIA.—Moving Disabled Trolley Car—Negligence—Damages—Pain and Suffering.

1. Where the trolley of a disabled car, which was being pushed by another car, jumped its wire, striking and breaking a cross wire, thus causing the accident to plaintiff, the question of negligence is for the jury, on testimony that the proper course was to tie down the trolley of the disabled car, and that the conductor thereof was told by the conductor of the other so to do, but refused or neglected.

2. Pain and suffering are a distinct item for which damages may be awarded in a personal injury case.

3. The Supreme Court will grant a new trial on the ground of excessive damages, under Act May 20, 1891 (P. L. 101), only in very clear cases of wrong or injustice, which the court below should have remedied.—(Schenkel et ux. vs. Pittsburgh & B. Traction Co.)

PENNSYLVANIA. — Collision — Contributory Negligence. Plaintiff's team being struck by a car on the down track, coming from the direction in which he had been going on the up track, just as he turned onto the track, and the testimony being merely that he did not see or hear, and not that he looked, and it being a clear day, and manifest that he could have seen it for a long distance away if he had looked, contributory negligence prevents recovery.—(Bolhmer vs. Pittsburgh A. & M. Traction Co., 45 Atl. Rep., 126.)

PENNSYLVANIA.—Contributory Negligence. Plaintiff is guilty of contributory negligence where, after stopping his horse 10 ft. or 12 ft. from a street car track, whence he could see one-fourth of a mile, and seeing no car, he attempted to go forward, but, on finding his team stalled, backed up 10 ft. or 12 ft., and then went forward with a spurt, not looking again, with the result that he was struck by a car.—(Kern vs. Second Ave. Traction Co., 45 Atl. Rep., 125.)

PENNSYLVANIA.—Injury to Person in Street. Nonsuit is properly granted in case of one who, though seeing a car on the track, attempted to cross, she testifying that as she went to the edge of the track she saw the car was moving, and that the dasher was in front of her, and that she was at the side of car when struck thereby, as she must have been struck by her coming in contact with the car by her voluntary act.—(Walsh vs. Hestonville M. & F. Pass. R. Co., 45 Atl. Rep., 322.)

PENNSYLVANIA.—Action for Personal Injuries—Instructions—Damages.

1. In an action against a railway company to recover for personal injuries alleged to have been occasioned by its negligence, it is not error to state to the jury that it was defendant's duty to furnish reasonably skilled and competent men to operate its cars, and "that is just where the plaintiff claims the defendant failed in its duty."

2. In an action against a railway company to recover for personal injuries, an instruction authorizing the jury, in assessing plaintiff's damages, to consider the expenses incurred as a consequence of the injury, the inconvenience and suffering naturally resulting from it, and the loss of earning power, whether temporary or permanent, consequent on the character of the injury, without explanation of the evidence or law applicable to either item, is inadequate.—(Todd vs. Second Ave. Traction Co., 44 Atl. Rep., 337.)

TENNESSEE.—Personal Injuries—Accident Between Crossings—Right of Way—Res Gestæ—Credibility of Testimony.

1. Plaintiff, who had been struck by a street car, testified in an action for damages therefor that he did not look and listen before attempting to cross the track, but in a second trial he testified that he did so look and listen. *Held*, that the jury, and not the court, must determine the credibility of his testimony.

2. The plaintiff was struck by a street car, and about fifteen minutes was occupied in extricating and caring for him at the place of the accident, when the motorman stated that he saw plaintiff, but thought he would get off the track. *Held*, that the statement was no part of the res gestæ.

3. Between street crossings, a street railroad company's right of way is superior to, but not exclusive of, the right of a pedestrian.—(Citizens' St. R. Co. vs. Howard, 52 S. W. Rep., 864.)

UTAH.—Personal Injuries—Liability—Negligence—Custom—Instructions—Reasonable Care.

1. However unusual the method of a common carrier, such as a street railway company, in starting its cars, if that method is dangerous, and its use violative of the high degree of care which the carrier is required to observe regarding its passengers, and in the use of that method a passenger is injured, the carrier is liable.

2. In an action for damages for personal injuries alleged to have been caused by the defendant starting one of its cars, on which the person injured was a passenger, in a reckless, careless, and negligent manner, the question for the jury is whether or not in this particular instance the car was started in a negligent, dangerous, or improper manner; and an instruction which, in effect, charges the jury that, if the officers of the defendant, by experience, were satisfied in their own minds that the method used in starting the car was reasonably safe, defendant would not be liable, is erroneous.

3. In such a case, an instruction that "the defendant, being a carrier of passengers for hire, the law imposes upon it a reasonable degree of care and foresight to prevent injuries to persons lawfully traveling in its cars," is defective in not defining to the jury what, under the law, a reasonable degree of care is.—(Dickert vs. Salt Lake City R. Co., 50 Pac. Rep., 95.)

UTAH.—Damages—Personal Injuries—Evidence—In Rebuttal—Contributory Negligence—Instructions—Negligence—Further Instructions.

1. In an action for damages for personal injuries caused by being run into by a street car, it is proper for plaintiff to prove in rebuttal a statement made by defendant's witness, who was motorman, immediately after the accident, at the place where it occurred, and in the presence of plaintiff and defendant's agents in charge of the car, which statement is inconsistent with the testimony of such witness from the stand.

2. Although plaintiff may have been negligent, yet if nevertheless the defendant could, by the use of proper and ordinary care, have prevented the injury, an instruction that "if in the hurry of the moment, or in a moment of forgetfulness, the plaintiff attempted to cross the track, without exercising that care which a man of ordinary prudence ought to exercise under the circumstances, he was guilty of contributory negligence, and cannot recover," is properly refused.

3. In such a case, an instruction that "if you believe from the evidence that the defendant's motorman had the least opportunity to avoid the accident after the negligence of the plaintiff, and failed to use all reasonable means to avoid the same, the defendant would be guilty of negligence, and would be liable," is properly given.—(Shaw vs. Salt Lake City R. Co., 59 Pac. Rep., 552.)

VIRGINIA.—Street Railway Crossings—Injury from Low Trolley Wire—Contributory Negligence.

1. Where plaintiff, a brakeman on a railroad crossed by an electric street railway, knew that the trolley wire sagged so low that it was necessary to stoop in order to pass under it with safety while on the top of the car, his ignorance of the danger attending contact with an electric wire in no way excused his fault in failing to exercise that reasonable care which would have enabled him to pass beneath the wire with safety.

2. An instruction that, though plaintiff was guilty of negligence that contributed to the accident, he could recover if the defendant, the street railway, could have, by ordinary diligence, avoided the accident, was not applicable to the facts.

3. Where a brakeman on a railroad crossed by defendant electric street railway attempted, in the performance of his duties, to pass from one car to another, while passing under the defendant's trolley wire, and was struck by the wire, which sagged to within a few feet of the top of the car, he cannot recover for such injury, though the defendant was negligent in so maintaining its wire over the railroad.—(Danville Street Car Co. vs. Watkins, 34 S. E. Rep., 884.)

VIRGINIA.—Action for Injuries—Trial—Instructions—Objections—Waiver—Pleadings.

1. Where the evidence in an action for injuries caused by defendant's alleged negligence in running its electric cars was conflicting, an erroneous charge that plaintiff was entitled to recover if her injury "was caused by defendant's servants," and without want of ordinary care on her part, was not cured by a subsequent correct charge that the mere fact that the injury was caused by

defendant's car would not entitle her to recover unless it was also shown by a preponderance of evidence that defendant was negligent.

2. It was error to charge that though plaintiff, in stepping on the track, failed to look and listen, she could recover, if by looking or listening she could neither have seen nor heard the approaching car, where there was no evidence on which it could be predicated.

3. An objection that an instruction assumes facts not in evidence is waived where instructions given at the request of the objecting party assume the same facts.

4. A complaint which alleges that plaintiff was struck by defendant's electric car while she was on the track, "upon which she had just stepped," is demurrable, since it conveys the idea that the collision was simultaneous with the plaintiff's act in stepping on the track, and therefore shows contributory negligence.—(Richmond Traction Co. vs. Hildebrand, 34 S. E. Rep., 888.)

PATENT DECISIONS

Patents—Validity and Infringement—Electric Railway Contact Devices.—The Anderson patent, No. 412,155, for an improvement in electric railway contact devices, consisting substantially in interposing metallic spring brushes between the forks of the trolley arm and the hub of the contact wheel, so as to encircle the spindle and bear upon the end of the hub, for the purpose of transmitting the current from the wheel to the trolley arm, construed, and *held* to show meritorious and patentable invention over the prior devices of the Heysinger patent, No. 395,607, and the Vandepoele patents, Nos. 396,310, 397,451 and 408,638; and also *held* infringed.—(General Electric Co. vs. Rahway Elec. Light & Power Co., 96 Fed. Rep., 464.)

PATENT DECISION.—Patents — Infringement — Trolley Tracks.

Claim 1 of the Coburn patent, No. 365,240, for an improved trolley track, as narrowed by amendment, while the application was pending in the Patent Office, to meet the objection of want of novelty and invention, covers only the specific device described, which consists of a tube "having the lower edges curved in toward the median line, and then turned upward, so that the bottom of the tube has a rounded trough at each side of a longitudinal central opening," and is not infringed by a tubular track similar in other respects, but having the sides turned in at right angles, leaving a flat surface for the track on each side of the opening, and fairly adapted to rollers with flat faces.—(Coburn Trolley-Track Mfg. Co. vs. Chandler et al., 97 Fed. Rep., 333.)

The Manhattan Railway Company, of New York, in the building of its mammoth steam-electric power station, has awarded to the Harrisburg Foundry & Machine Works, the contract for the engines to operate the exciter dynamo in its new Seventy-seventh Street power house. Ordinarily an order for engines simply to operate exciters would be a small affair, but in this case, on account of the huge proportions of the plant, it amounts in the aggregate to 1600 hp, quite a power plant in itself. This was an order that attracted unusual attention among both users and builders of engines, for the new station, where the engines are to be installed, is designed to be second to none in the completeness of its equipment, and no pains were spared in the selection of the very best machinery of all types for the various services required.

The exciter engines are four in number, each of 400 ihp capacity, each direct connected to a 250-kw direct-current dynamo of the Westinghouse Electric & Manufacturing Company's make. These dynamos have eight poles, are wound for a 1000 amps. at 250 volts, and are guaranteed for an efficiency of 93 per cent.

The Harrisburg engines are of the tandem compound type, the cylinders being 14 ins. and 25 ins. diameter by 18 ins. stroke. They are to operate at a speed of 200 r. p. m., with 150 lbs. steam pressure condensing.

Improvement in Bergen County.

The opening of the new Hackensack line of the New York & New Jersey Railway & Ferry Company, the new name of the Bergen County Traction Company, was chronicled in the issue of the STREET RAILWAY JOURNAL for June 23. The company is also making a number of additions to its power station and rolling stock. In the power station, which is at Edgewater, the company is placing two new batteries of boilers of 750 hp each, or a total of 1500 hp, together with a new generator of equal capacity. This gives an additional power greater than the entire output of the old plant. The boilers will supply the necessary steam for a cross-compound Hamilton-Corliss engine of about 1500 hp. The company also contemplates making a further increase next December. This would have been done at the present time, but for the inability to secure machinery from the manufacturers.

New Publications

Historic New Hampshire. 62 pages. Published by the Exeter, Hampton and Amesbury Street Railway Company. Illustrated.

This interesting pamphlet contains much historical information regarding the territory covered by the lines of the company, and describes in a pleasant manner the various "sights" which may be observed by the passengers on the road. Although intended primarily for these patrons, a complete, illustrated description of the power plant, etc., is given at the end. Numerous half-tones are distributed throughout the text, and a map of the railway is included.

Trolley Trips In and About Fascinating Washington. By Katharine M. Abbott. Published by J. F. Jarvis, Washington, D. C. 127 pages. Illustrated. Price 10 cents.

This entertaining little book is quite a complete guide to the public buildings and other points of interest around the capital, as well as being very useful to those who wish to find the pleasantest and most convenient way of getting around. The principal goals of the sightseer are well illustrated and described. In the back is found a folding map of the city with the various trolley lines designated thereon, and the back cover contains a map of the city and suburbs.

Railroad Construction, Theory and Practice. By Walter Loring Webb. Published by John Wiley & Sons, New York, 46 pages. Illustrated. Price $4.00.

Intended for a text-book and not a reference book, this volume is perhaps of less value to the practical engineer than to the student; but it may well find its way to the engineering office on account of its concise explanations and numerous references to original scientific papers. The parts of the book devoted to practice have necessarily been largely taken from such papers, and, with possibly the single exception of the chapter on tunnels, represent the most modern methods and figures. It is unfortunate that nothing is said about track in paved streets and bonding, although the subject of street railways is not supposed to be covered. The last quarter of the book is composed of tables, and an ingenious cardboard slide rule is found in a pocket on the inside of the back cover. The slide rule is intended for the computation of complicated earthwork problems, but the author fails to warn the student against too free a use of it in actual calculation. Many of the tables have been specially computed, and their excellent typography makes them a feature of the volume.

Modern Electric Railway Motors. By George T. Hanchett, M. E. Published by Street Railway Publishing Company, New York City. 200 pages. Illustrated. Price $2.00.

This book relates entirely to the description, design and management of electric railway motors, the author assuming from the first that the elements of electricity and magnetism have been previously understood. Although, perhaps, not intended primarily for a text-book, the arrangement is such that it would prove satisfactory in class-room work. The subject is treated in a strictly up-to-date manner, the latest apparatus, both American and foreign, being described, as well as a few of the older motors which are still in use. The excellent educational method of comparing the advantages and disadvantages of each set of systems or apparatus as it is explained is pursued throughout the work, and all abstract descriptions of the various types of fields, armatures, etc., are invariably followed by references to actual machines, thus fixing in the mind of the reader their application. The chapter on management and repair contains many useful hints for the car house and shop; and that on design, with its complete calculation for a modern type of motor, although necessarily not exhaustive, will be found of service to those entering this field. A folder in the back, giving authentic dimensions and other important data of all the best makes, will be welcome to both manufacturer and railroad man. The illustrations are numerous and good, and what is said is well said.

As an evidence of progress in Western engineering, it may be noted that the city engineer of Chicago recently placed with the Bethlehem Steel Company an order for a hollow-forged shaft to replace a breakdown in the North Side pumping station at that city. The new shaft, which measured 13 ft. 8½ ins. in length, 19 ins. in diameter, and weighed close to 10,000 lbs., was booked on May 30, and, under special emergency instructions, was hollow-forged, annealed and rough-machined in time to go forward June 9.

Many of the power stations in Chicago and other Western cities are equipped with shafts of this description, but this is the first time a hollow forging has been specified for water works engines in that section of the country.

Steel Rolling Doors

The cuts on this page illustrate a type of door which is peculiarly adapted to requirements of a car house. The manufacturers have increased its value for such uses by the addition of several ingenious devices which automatically insure a continuous trolley wire when the door is open, without in any way interfering with its operation.

The detail drawings show this arrangement; one with the door open, the other with it closed. The trolley wires on both the outside and inside are fastened to insulated blocks (*c*, *c* in the figure) which are connected by means of a wire running around the roller on which the door is coiled, and through a hole in the wall of the building. When the door is open the angle bar (*b*) fastened at right angles to the lowest segment fits over the guides (*a*, *a*), and forms a continuous path on which the trolley may run. To remove the strain from the blocks (*c*, *c*) guy wires, with turn buckles, are run out a few feet to the trolley wire from the wall.

The roller for the door is supported on strong brackets, and is revolved by means of an endless hoist chain and train of gears. As the sides require only a small groove to run in, every portion of the space is economized. When the door is up the entire opening is available. It is claimed that no matter how large this opening may be, it can be similarly treated, a door being now in process of construction which is 36 ft. wide by 20 ft. high, weighs 6200 lbs., and is probably the largest ever built.

A photograph of the car house of the Sioux City Traction Company, Sioux City, Ia., is reproduced to show the general appearance of the equipment in operation.

The doors above described are made by the Kinnear Manufacturing Company, Columbus, Ohio, which is the sole manufacturer.

CAR HOUSE AT SIOUX CITY

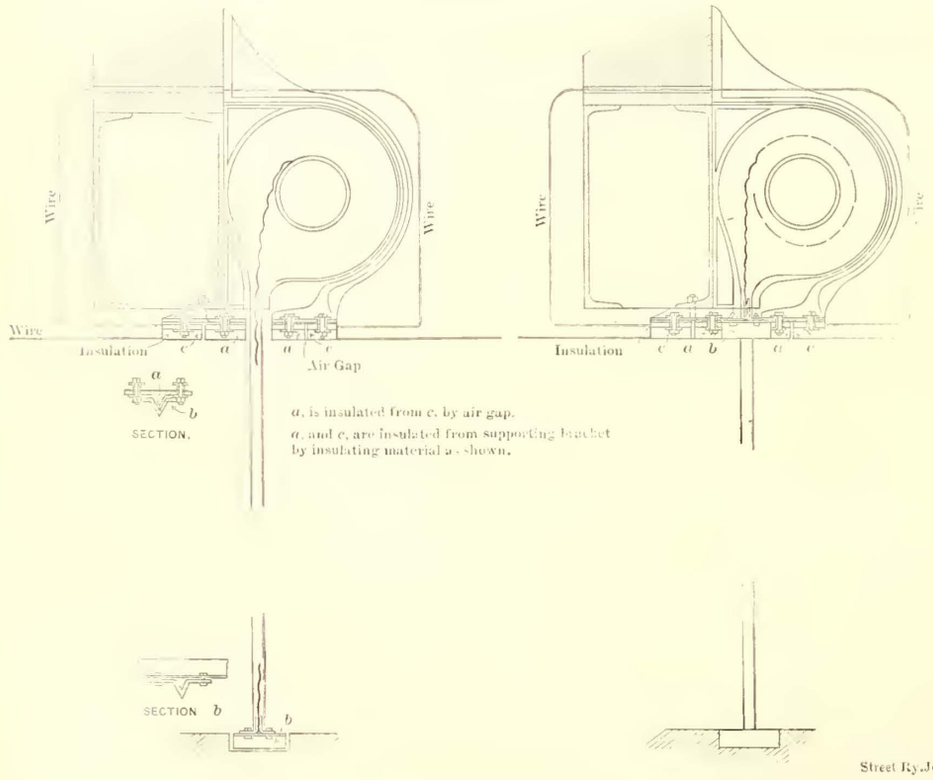


DIAGRAM SHOWING ARRANGEMENT OF DOORS

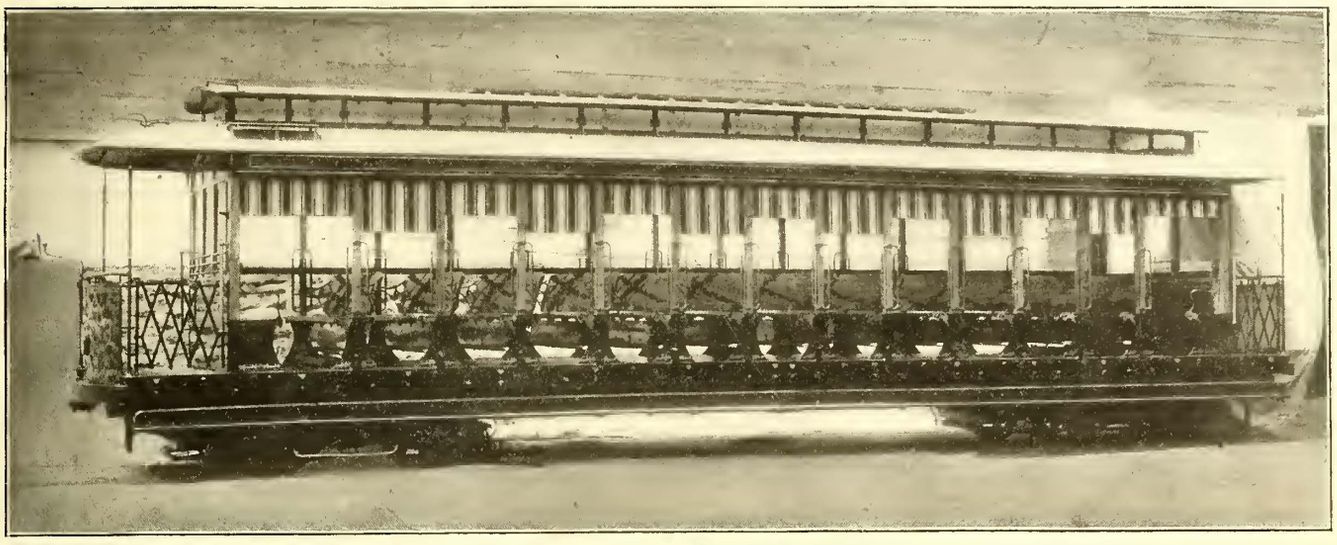
Some Recent Foreign Orders

The Morris Electric Company has been responsible for quite a large proportion of the exports of electrical apparatus which the daily papers have been mentioning for the past six months. Among other contracts which this company has made, and to which material has been shipped during the past six months, has been the supply of all the trolley, feed and span wire for the equipment of the Havana Street Railway Company. This company, as is well known, is building a large system in the capital of Cuba, and the feed wire contracts alone, it is said, involve an expenditure of over $200,000. For the same road the Morris Company has also filled an order for 2200 iron poles with brackets, fittings and appliances, 45,000 ft. of iron standard span wire, and 60 carloads of terra cotta ducts. These orders were placed with the Morris Company by George F. Greenwood, general manager of the Havana Street Railway Company. Two other railway companies for which Mr. Morris and the Morris Electric Company have supplied a large part of the material have been the Federal Street Railway Company, of Mexico City, and the Lisbon Tramways Company, of Portugal, both of which are controlled by the London bankers, Wernher, Beit & Company.

The Morris Company has also done a large amount of other foreign business in Europe, Africa and South America.

Large Open Cars

The engraving given herewith shows a fourteen-bench open car recently built for the Buffalo Railway Company, Buffalo, N. Y., by the J. G. Brill Company. These cars are interesting on account of their great size and the fact that they are mounted



LONG OPEN CAR FOR BUFFALO

on No. 27-F trucks. They are driven by four G E-57 motors ,and weigh without equipments 24,500 lbs. The trucks weigh about 5500 lbs. each. They are equipped with electric brakes and have electrice headlights. Bronze trim is used throughout, except for the grab handles, which are of malleable iron. There are two Dedenda gongs. Brill gates inclose the platforms, and the curtains when down reach to the floor.

The peculiar forms of the grab handles and inside guard rail are due to the great size of the cars. They are 41 ft. 10 ins. over the corner posts. Having a platform 3 ft. 8 ins. wide, they measure 49 ft. 2 ins. over the dashers. The extreme width is 8 ft. 2½ ins. The running boards are 19½ ins. from the head of the rail, with a 17-in. riser. The width gives 7 ins. more space on a seat than is usually allowed for five persons, making it possible by tight squeezing to put six passengers on a seat, although the nominal seating capacity of the whole car is but seventy. The step or running board is divided or closed in the centre and closes against the side of the car. The trolley board is insulated from the body of the car and the sound of the trolley deadened by the use of rubber.

Smokers will find the cars provided with one unusual little convenience—a match striker on the post. In designing these cars the management intended to provide seating capacity sufficient for all the passengers the cars were to carry, and made no provision whatever for standing room.

The New York & New Jersey Railway & Ferry Company, of Undercliff, N. J., has just purchased a large number of fine open cars, each equipped with four G. E. 67 motors, and mounted on Peckham 14 B 3 trucks. All trucks are fitted with the Price momentum brake, built by the Peckham Company, and which has proved very efficacious on the many grades on the line. Arc headlights are used.

Central London Railway Car

Frequent reference has been made in the STREET RAILWAY JOURNAL to the Central London Underground Railway of London, and through the courtesy of the Brush Electrical Engineering Company, Ltd., of London, a view of one of the new cars, recently completed by this company for service on the Central London road, is given.

The main dimensions of these cars are:

Length over buffers	46 ft. 3 ins.
Length over headstocks	45 ft. 6 ins.
Length over body	39 ft. 0 ins.
Width over panels	8 ft. 6 ins.
Width at roof line	8 ft. 3 ins.
Height inside at middle	7 ft. 5 ins.
Center to center of bogies	29 ft. 6 ins.
Wheel base of bogies	5 ft. 0 ins.
Diameter of wheels on tread	2 ft. 5 ins.
Size of journals	6 ins. x 3 ins.
Center to center of journals	6 ft. 0 ins.
Gage	4 ft. 8½ ins.
Seating capacity	48 passengers

The seats are arranged longitudinally at each end with suitable arm rests, and at the center there are four rows of cross seats; this arrangement is necessary to allow the wheels to swivel under the longitudinal seats, as the cars are to run with ample clearance in an 11-ft. 6-in. tunnel, with the rails laid at a height of 1 ft. 7½ ins. from the invert of the tunnel. The seats and backs are provided with Wood's woven wire frames and upholstered in blue and crimson moquette velvet. The inside of carriage is paneled on the sides and ends with best white sycamore veneer; the panel framings are of light colored teak with teak moldings to match. The roof is arranged in three panels longitudinally and are covered with millboard ¼ in. thick, each panel having an ornamental lincrusta border carried along the sides and ends. Hand straps for the use of passengers are secured to a teak rail running the whole length of the carriage on the sides of the clere-story.

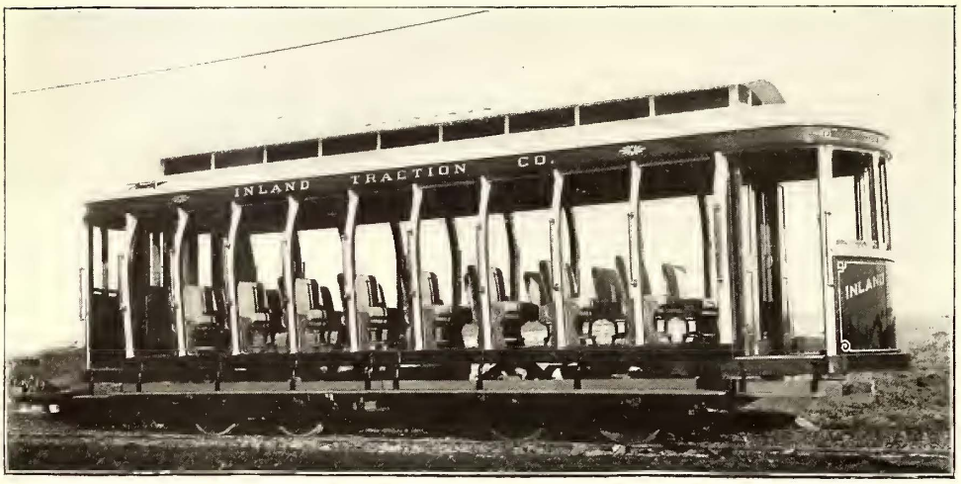
CAR FOR CENTRAL LONDON UNDERGROUND RAILWAY

Brass baggage racks made of expanded metal, as well as hat and coat hooks, are provided along each side of the car. The whole neatly finished and lacquered. Ample ventilation is secured by means of hit-and-miss ventilators fitted to the sides of the clere-story, and hinged ventilators directly over the windows. In

addition ten "torpedo" air extractors (five along each side of roof) are used.

The roof is supported by channel steel carlines, and further strengthened at the center by two T steel arch bars, carried across the roof and down the sides of each cant rail. These carlines are covered with ornamental teak facings.

The whole of the body framing is made of well seasoned teak,



DUPLEX CAR FOR SOUDERTOWN

the side framing is trussed with diagonal braces, strap bolts and vertical tie rods.

The whole of the underframe is of rolled steel channel section, firmly bound together with knees and gusset plates.

The truck frames are of pressed steel made by the Leeds Forge Company. The truck centers are of cast steel with ample wearing surface and are mounted on spring bolsters also of pressed steel.

The axles are of best Siemens-Martin steel with wheel seats 4 ins. in diameter. The tires are 4½ ins. wide x 2 ins. thick and of Siemens-Martin steel. The wheels have wrought-iron bosses with teak centers and have Mansell's retaining rings. The wheels are forced on to the axles by hydraulic pressure of not less than 50 tons, without keys.

The cars are arranged with platforms at each end 3 ft. 3 ins. long with Gold's American automatic locking gates on each side of platform. The platform is further protected by iron screens 4 ft. 6 ins. high, with cross-over protected by chains. As a further safeguard a collapsible gate is fitted at opposite corners of each car, preventing passengers getting between the cars.

Each end of each car has a special arrangement of draw and buffer gear with India rubber springs and steel recoil springs. The whole of the draw-gear is of best Yorkshire iron.

The cars are fitted with the Westinghouse quick acting brake with brake rigging of best hammered scrap, and all joints and pins properly case hardened.

Each car is fitted with ten electric lamps on two circuits, eight being inside and one at either end over the gangway, with junction boxes and flexible couplings between each car. Two oil lamps are fitted over each door for use in case of emergency.

The outside of the carriage is painted similar to the London & Northwestern Railway Company's stock. The body below the waist panels is painted purple lake, the waist panels and upwards are painted white and the moldings are painted purple lake throughout, with gold lines along the edges.

The end coaches of each train are arranged as smokers. They are upholstered in maroon haircloth and are provided with special drawgear for attaching to the electric locomotive.

Foundations have just been completed by the United Railways & Electric Company, of Baltimore, Md., for some very extensive repair shops in that city.

Duplex Car for Soudertown, Pa.

The accompanying engraving shows a combination open and closed car of the Duplex type, made by the Duplex Car Company for the Inland Traction Company, of Soudertown, Pa. The car is one of several of the same type built for this road, and is shown as an open car. The panels, of course, are slid up into the roof and can be dropped down within a very few minutes, and thus convert the car to closed car if desired. This feature of the ability to change the car quickly from open to closed and vice versa is one upon which the manufacturers of the car lay a great deal of stress. They claim that where the panels are detached from the car and stored during the summer, the main advantages of a duplex car is lost, as there are many times during the summer, as well as during the spring and fall months, when a quick change is desired, and if the panels are stored and have to be brought out and attached to the car to convert it, the delay in doing this will be so great as to lose the advantage in making the change. Again, when parts of this kind are stored, the chances of detioration are certainly as great, if not greater, than when they are carried on the car always ready for use.

The company reports doing an excellent business, and has recently been receiving orders for cars of the same type as that shown in the engraving from roads in Bellows Falls, Vt; Nelson, British Columbia; Lincoln, Neb.; Gardiner, Mass.; Allentown, Pa.; Buffalo, N. Y.; Schnectady, N. Y.; Bordentown, N. J.; Wilmington, Del., and elsewhere, as well as from roads abroad.

A Massachusetts Suburban Car

The accompanying engraving shows a type of car which has proved quite popular upon a number or roads in Eastern Massachusetts. The car shown is one built by the Laconia Car Company for the Blue Hill Street Railway, but the same car is used on the Brockton & Plymouth Street Railway and others.

CLOSED CAR FOR BLUE HILL

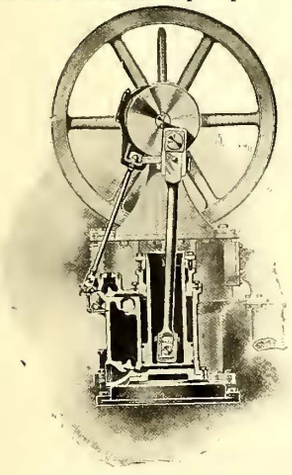
The car measures 40 ft. over all and has straight sides sheathed like steam railroad cars. There are ten double sash windows on each side, both sash being arranged to drop flush with the window sill. As the window sill is only 27 ins. above the floor, this makes practically a summer and winter car. There are ten reversible seats on each side, upholstered in rattan. The interior of the car is finished in quartered oak. The cars are furnished with the Laconia double trucks and Christensen air brakes.

Combined Air and Circulating Pump

The accompanying illustration shows a new combined air and circulating pump, recently brought out by the Conover Manufacturing Company, of New York.

The demand for economical results in modern power plants is rapidly extending to all parts of the equipment. Too little attention has been paid to the auxiliaries, and wide awake owners are no longer content to have only the main engines of the most efficient design, but insist on equal economy throughout. None of the parts of a modern plant is more important than the condensing apparatus, and especially in a surface condensing arrangement it is essential that the air and circulating pumps be of the most economical design in order to get efficient results. The air and circulating pump illustrated is very heavy in design, and being operated by a compound Corliss condensing engine the economy naturally is of a high order.

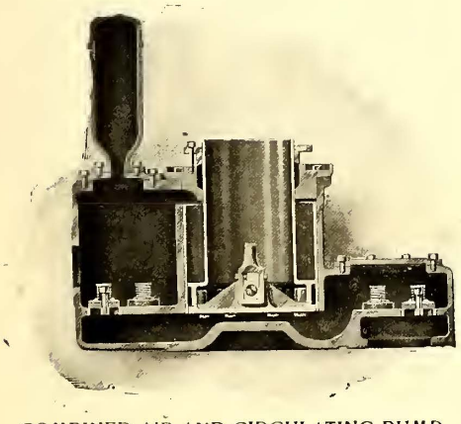
This engine is the same as used on the Conover jet condenser, which has proved its efficiency by years of use in the numerous large plants both here and abroad. The air pump is the regular Conover pattern, vertical, single-acting, and is made amply large for the slowest revolutions required to give the proper amount of water through the circulating pump. The pumps are arranged to vary the speed to give the proper amount of circulating water through the surface condenser at all times, the air pump taking care of itself. The air pump, excepting for the slight difference in friction, requires practically the same power to operate it without reference to the speed. As the same water and air are delivered in each case, a faster speed merely delivers a smaller quantity at each stroke, and proportionately reduces the mean effective pressure. This arrangement, therefore, gives all the advantages of separate air and circulating pumps in a combined machine, with less work to look after them and a much higher grade of economy.



CROSS SECTION OF ENGINE

The circulating pump is of the double acting, trunk displacement type, which gives a very steady discharge, and only requires one set of suction and discharge valves.

A cross section of the engine is shown. It will be seen on examination that this engine is compound condensing in one cylinder, and only takes steam once for a full revolution.

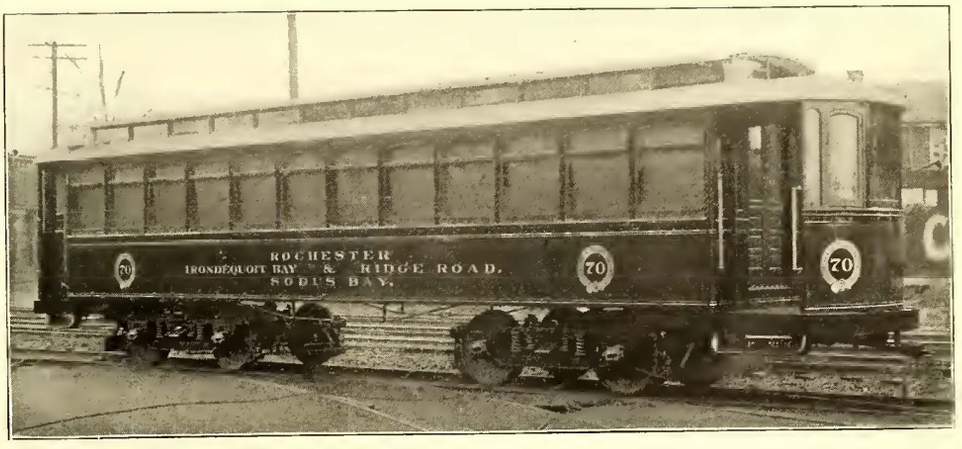


COMBINED AIR AND CIRCULATING PUMP

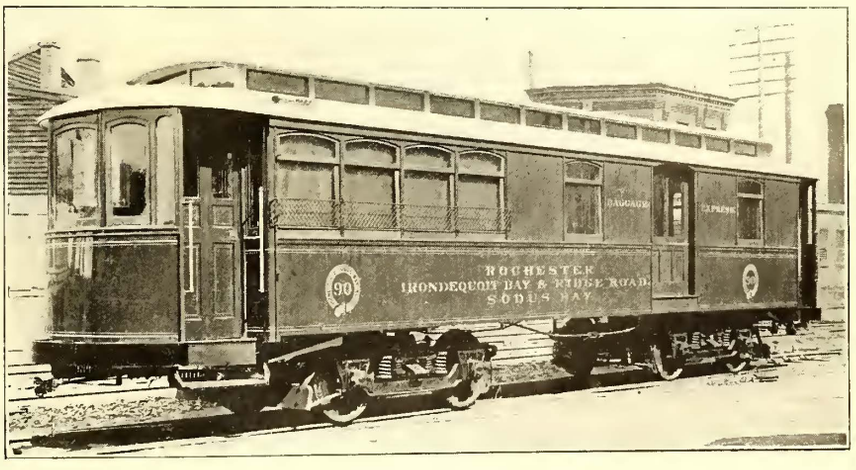
Long Cars for Rochester

The Jackson & Sharp Company, of Wilmington, Del., has just completed a number of long suburban cars for the Rochester & Sodus Bay Railroad, of Rochester, N. Y. The cars are illustrated herewith. The passenger cars, six in number, are 35 ft. long in frame, and 44 ft. 6 ins. over all. They are fitted with vestibules and side folding doors at each end. The interior finish is of quartered oak, in neat design, with carved mouldings, etc. They also have basket racks like those used in steam cars. In one end of the car a smoking room is provided. This room is more on the style of the smoking compartments in Pullman cars than anything yet attempted in cars for electric service. The distance of three win-

INTERIOR OF CAR



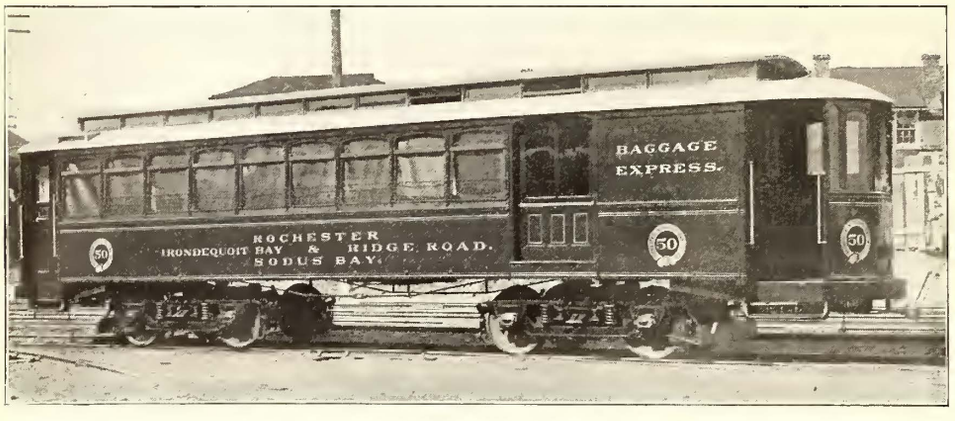
PASSENGER CAR



CAR WITH LARGE BAGGAGE COMPARTMENT

dows at one end is appropriated for this smoking compartment, and the entrance is from the platform.

At the end of the car are placed two hinged doors, one leading into the car proper through a passage way along the side of the car, and the other into the smoking room, which is provided with side slat seats, having seating capacity for eight to ten passengers. This room is also fitted with basket racks as well as coat and hat hooks.



CAR WITH SHORT BAGGAGE COMPARTMENT

The passenger end of the car is fitted with cross seats, upholstered in rattan. The windows are fitted with Pantasote curtains, made by the McKay Curtain Company, and fitted with patented fixtures. The car has seating capacity for forty-five passengers.

Owing to the large amount of country produce and baggage carried by this road, it has also ordered from the Jackson & Sharp Company eight combination passenger and baggage cars, as shown in the engraving above. These cars are like the passenger cars described above, except that 10 ft. of the space is appropriated for the baggage compartment, leaving 25 ft. for passenger service. The seating capacity of the passenger compartment is thirty-six, besides room for smokers in the baggage room, where folding seats are provided.

Four cars like those illustrated in the third engraving were also built for this road. These cars are also 35 ft. in frame and 44 ft. 6 ins. over all. Only 10 ft. of this space is appropriated for passenger service, and the balance, or 25 ft., is used for freight, produce, etc. The Jackson & Sharp Company is also building ten fifteen-bench open car bodies for the Rochester & Suburban Road.

The Wastefulness of Chimney Draft

In a recent editorial discussion of the question of the various methods for the utilization of waste heat, the *Engineer* considers, among other features, the usual method of producing draft by the ascent of heated air in a chimney.

Taking the boiler as the wasteful member in a steam plant, its efficiency varies from 60 per cent in a bad boiler to 80 per cent in a very good one, these proportions of the heat produced by the combustion of the coal being realized in steam available for the engine in each case.

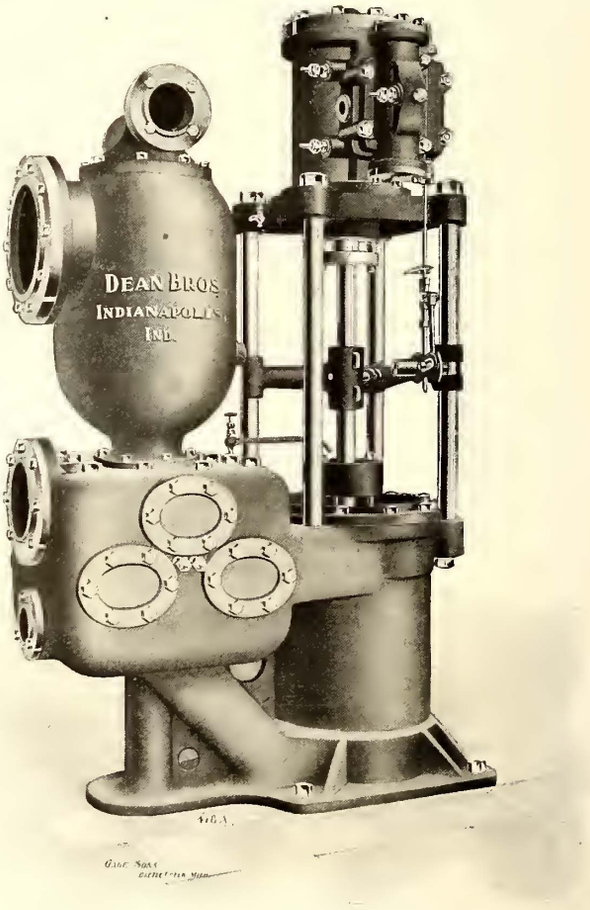
"The difference may be said, without greatly stretching the truth, to go up the chimney. It is not to be disputed that much of the waste heat might be caught and utilized, but there are reasons why it is not so caught. In the first place, the gases must be hot when they go into the chimney, or there will not be a draft.

"As a matter of fact, a draft got in this way is the most expensive possible, save one. The exception is a steam jet in the chimney. A fan can be run for about one-tenth of the power represented by the waste heat required to command a good draft. A tall chimney will cost from $5,000 to $25,000—very much more than will a fan plant. But the fan is not used and the chimney is, largely because it is essential to discharge the products of combustion high up in the air over the roofs of surrounding houses. This necessity must be taken into account in so far as factories are concerned, but it does not hold good of steamships; yet we believe that in most cases a chimney stack 100 ft. high would be sufficient, because with a fan, combustion could be more easily controlled than is possible with a chimney, to the end of preventing the giving off of smoke."

Vertical Double Acting Air Pump and Jet Condenser

It was formerly supposed that a vertical air pump must be single acting, but Dean Bros., of Indianapolis, have perfected a vertical air pump that is double acting, and is therefore double the capacity of a single acting air pump of the same dimensions. A view of this machine is given herewith. It is especially adapted to the requirements of high pressure, high speed engines, and is claimed to be more economical, more efficient, simpler and safer than than air pumps connected to the engine.

It is started before the engine, and the vacuum obtained is used to assist in the first revolutions. This feature is almost indispensable with triple expansion engines, as the full power of the low-pressure cylinder is secured at once. It adds nothing to the load of the engine, and takes less than half the power of a pump operated by the engine. The air pump is bronze lined, and has a bronze piston rod. There are no valves in the piston, all the valves being in the water chest at the side where they are quickly accessible. It is claimed to save 20 to 30 per cent of the steam used by the engine, and can be operated on one-half of 1 per cent of the steam consumed by the engine. It is manufactured by Dean Bros. Steam Pump Works, Indianapolis, Ind.



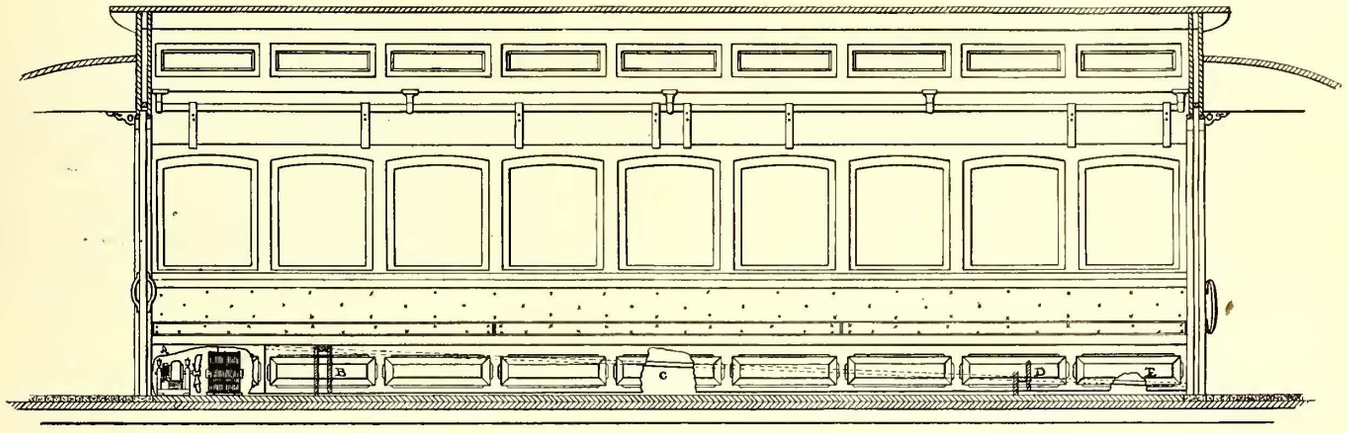
VERTICAL AIR PUMP AND JET CONDENSER

The Société Générale des Tramways Electriques en Espagne, which was formed last year in Madrid, Spain, with a capital of f.10,000,000, is about to increase its capital to f.20,000,000 for the purpose of building new electric tramways in various parts of the country. This company controls all the tramway lines in Madrid, most of which are still run by horse power. This increase of capital is for the sole purpose of converting the entire horse car system into electric traction.

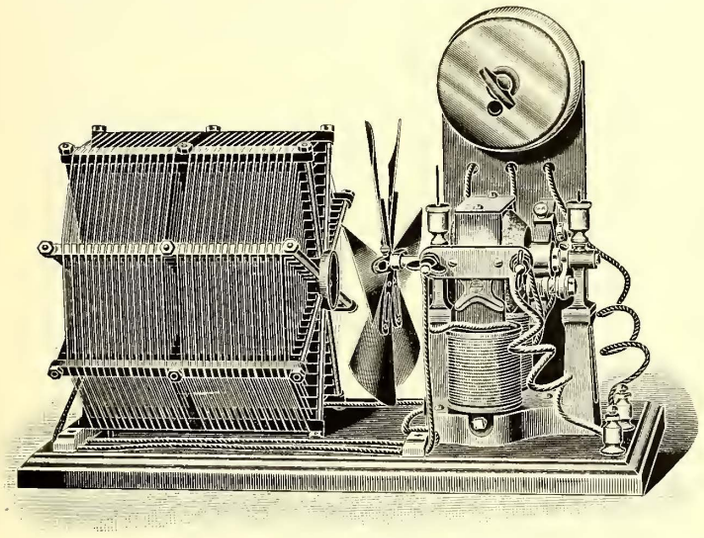
An Improved Electric Car Heater

The problem of sanitation and economy in the heating of electric cars is one requiring much consideration. A heater that makes use of every heat unit employed, keeps the air in circulation, and uses only pure air from the outside of the car would seem to be most desirable. The cuts accompanying this article illustrate a system which is claimed to fulfill these conditions without its being difficult to install or encroaching upon the passenger space of the car.

The heater consists of a heating web woven with special resistance wire, by means of which the heat is generated. One heater is sufficient for an electric car with an inside length of 25 ft., but two may be employed if considered an advantage for any particular reason. Behind the heating web is placed a fan motor of special construction, which, with an ingenious arrangement for forcing the air equally to all parts of the car completes the entire heating apparatus. The heating web and motor are enclosed in a case, which can be removed at will from the car, or they may be permanently located in the car. In either case they occupy but small space, and can be placed under the seat at the end of the car, or under the floor of the car itself. The heat issues at the floor, and at all parts equally, thus heating a part of the car not affected by a stationary heater. In connection with the heater a special switch is used, constructed so as to admit of the regulation of the heat. The accompanying illustration gives an idea of the heater and motor as they appear before being enclosed. In operation, no parts whatever are visible to the occupant of the car, and it is claimed that no parts can be over-heated.



SECTION OF CAR, SHOWING HEATER



ELECTRIC FAN AND HEATING WEB

The fresh air from the outside is heated directly, and, by means of the fan, is forced into the car, thus putting the entire body of air in circulation, the heat being evenly distributed.

The manner in which the air enters the interior is shown in the section given of a car equipped with this apparatus. The riser under the seat does not quite reach the floor, thus leaving a narrow slit the entire length of the seat for the admission into the car of the heated air. A longitudinal partition gradually diminishes the size of the air chamber under the seat, so that although the pressure falls off as we recede from the fan, an even flow throughout the entire length of the slit is secured. In the drawing this partition may be seen where the panel is cut away at *C*, the dotted line showing how it slopes from one end to the other.

It is claimed that this system has many advantages over the stationary heaters commonly used. Among them may be mentioned the impossibility of over-heating the woodwork, cushions, etc., and the greater rapidity with which a car can be heated. The heater itself does not rise to a very high temperature, as the continual current of air being warmed prevents its retaining the heat. No metal whatever, appears on the surface of the car riser, or at any point where it could be seen or felt by persons in the car.

The system above described is being brought out by Bay State Electric Heat & Light Company, of Boston, Mass., and is called the Bay State heater. The apparatus is being tested by some large companies, among them the Lynn & Boston Railroad Company, and it is claimed that the results bear out fully the theoretical prophecies.

The Spiral Nut-Lock

The novel nut-lock illustrated on this page is being brought to the attention of railway men throughout the country. S. A. Crone, formerly master car builder for the New York Central Railroad and a past president of the Master Car Builders' Association, has been made selling agent for the Spiral Nut-Lock Company, which is placing the device on the market, and he has succeeded in interesting many of the large roads in what he claims to be the simplest, cheapest and most effective nut-lock ever produced. Since its introduction less than a year ago numerous tests have been made on tracks, locomotives, steam drills and hammers, and other places where the vibration caused all formerly used locking devices to fail, and in every case the company reports satisfactory operation.

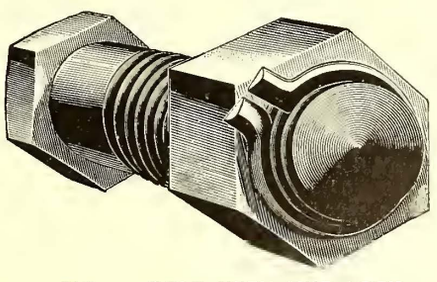


FIG. 1.—BOLT WITH NUT LOCK

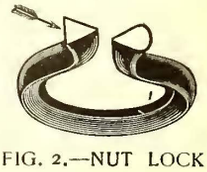


FIG. 2.—NUT LOCK

The nut-lock is made of crucible steel triangular wire, bent cold and tempered. It is made a little smaller than the diameter of the bolt, but after it has been started on the end of the bolt any leverage applied betwen the projecting ends, such as a screwdriver or flat key, will spring the lock open enough to allow of its being easily screwed up against the nut. The curve of the spiral changes as shown in the cut, and in order that the entire circumference of the thread may be gripped effectively, the nut-lock must be put on "right side out." This is made very simple by having the end which is first to engage the thread flattened, as shown by the arrow in Fig. 2, so that the workmen can tell at a glance which way to apply it. The removal is as simple as placing it in position, and should it be rusted on a blow from a hammer will break it off. The

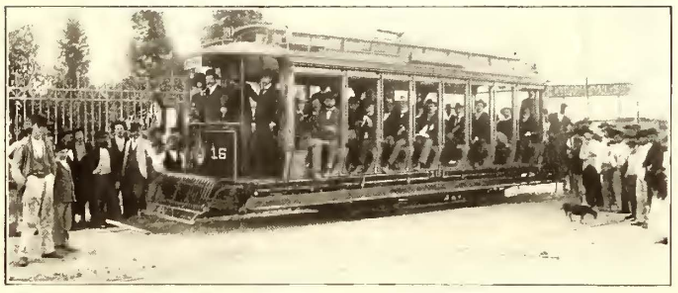
price is claimed to be lower than that of jam-nuts of the same size, and a shorter bolt can be used than would be necessary with any kind of split washer, jam-nut, etc.

Perhaps the reason for its tenacious grip on the thread of the bolt is due to the fact that the nut only touches the spiral for about one-third of its length, thus reducing the power which it would have to turn the nut-lock.

Opening of a New Electric Railway in Brazil

The first section of the electric tramway system of the Sao Paulo Electric Railway, Light & Power Company, Ltd., which was described in the STREET RAILWAY JOURNAL for July, 1899, was put in operation last May. As will be remembered, this line is being built by American engineers and American capital, and the construction of the road was carried on largely under the personal direction of F. S. Pearson, of New York, who is largely interested in the enterprise.

The daily papers published in Sao Paulo immediately after the opening of the first section of the line, have just arrived in this country, and announce the great interest taken in the electric cars, and the enthusiasm of the inhabitants over the inauguration of the



FIRST CAR ON BOM RETIRO LINE

electric system. The following account of the opening of the line is taken from one of the leading Sao Paulo papers.

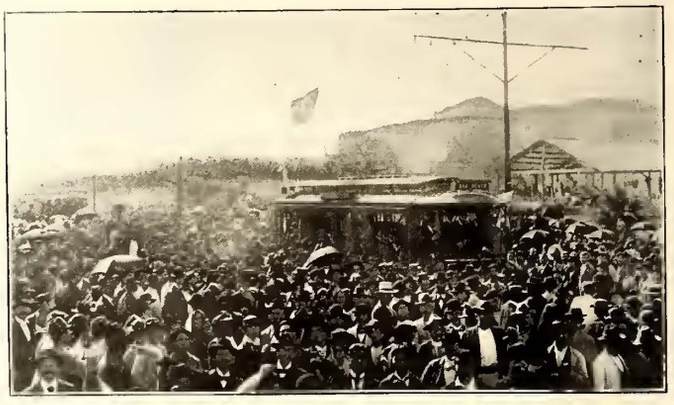
"In the hurried lines of a notice which suffers from the haste with which it is written it is impossible to give the exact measure of the intensity of joy and satisfaction which was visible in the looks of all on account of the realization of so notable an improvement. The enthusiasm of the people crowding on the streets through which the vehicles ran is indescribable, and when the cars were placed at the orders of the public after the inauguration, one can hardly imagine the extent of the invasion that took place. Everybody made efforts to obtain seats in the cars, but in spite of the natural confusion of such occasions, not the slightest incident took place that might sound a discordant note in the great festival, in which the people took part with the highest demonstration of joy.

"Having given in the beginning this salient point, we will describe the inauguration of the great improvement according to the notes we were able to take.

"As had been arranged, several persons invited had repaired at 12 o'clock to the building in Rua Direita, where is the office of the Sao Paulo Railway, Light & Power Company, Ltd., and the store of James Mitchell & Company, to set out together from there to the company's power house, where the president of the State was to start the principal engine, while the other guests were at the car house at Alamedo Barae de Limeira, at 2 o'clock, the hour for the inauguration. At the company's power house at the Rue Monsenor Andrade, where the guests arrived at 1 p. m., there were Dr. Oliveira Ribeiro, chief of police, accompanied by his aide-de-camp, Captain Ozorio, and Dr. Cerqueira Cezar, president of the Senate, besides Dr. Campos Porto, representing the Platea, and Sr. Anibal Machado, of the Imperio, and other engineers of the company. Afterwards there arrrived Dr. Rodrigues Alves, president of the State, his aid-de-camp, Captain Jayme Marcondes, Dr. Prudente de Moraes, accompanied by his son, Antonio Prudente de Moraes.

"At twenty-five minutes past 1 Dr. Roiz Alves started the big engine by moving the throttle valve; a few moments afterward Drs. Roiz Alves, Prudente de Moraes, Domingos de Moraes, Bento Bueno, Francisco Malta, Cerqueira Cezar and Mrs. Burchard made the several connections of the current producing and safety apparatus, transmitting the electric energy to the cables and supplying light, which appeared in all the lamps of the building. After a short examination of all the machinery and the great boilers, the guests started for the car house at the Alameda Barao De Limeira, where they arrived at 2 o'clock.

"There were present Dr. Albuquerque Luis, president of the Camaraete, representatives of the prefecture, and many other deputies, senators, and a great host of persons, whose names it was impossible to take down. After a rapid visit to the storehouse, the guests took their places in the six cars, which were in front of the building. The cars were decorated with flags and festooned, the Brazilian, British and American flags being seen at the top.



OPENING OF LINE

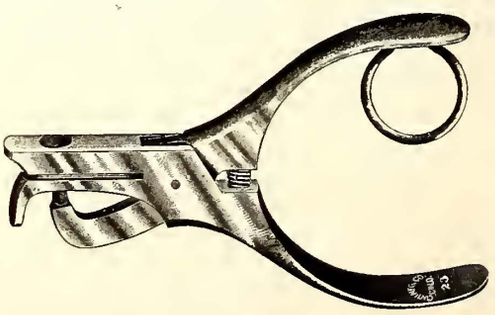
"At ten minutes past two, when the National, British and American hymns were being played, the cars started, making the inaugural trip along Alameda de Limeira, etc. Along the whole line the crowd of people was immense, greeting the electric company, and the windows were filled with families looking on. From Largo Sao Bento all the cars returned as far as the temporary terminal point at the end of the Alameda Barao de Limeira, where they again returned to the car house. There a profuse and liberal lunch was served, 200 persons sitting down at the table, the service being done by the Confeitaria Castelloes. During the lunch the band played several pieces.

"On serving the champagne Dr. Carlos de Campos arose, and in the name of the company greeted the President of the State and Municipal Prefect, as representing the people. Dr. Antonio Prado, referring to the great improvement, introduced in this capital, greeted the Electric Tramway Company. Mr. Brown, superintendent, returning thanks for the toast which had been proposed, drank to the prosperity of the State of Sao Paulo and the agrandisement of the Brazilian country.

"The toast of honor was proposed by Dr. Roiz Alves to Dr. Campos Salles, president of the Republic, this toast being enthusiastically responded to, the band of the police brigade playing the National Hymn. During the remainder of the afternoon the electric cars were offered gratuitously to the public, making several trips between Largo Sao Bento and Alameda Barao de Limeira, carrying a considerable number of passengers, many hanging on at the sides. At 7 p. m. the traffic was suspended, to begin today the regular trips."

An Improved Ticket Punch

The form of punch illustrated herewith is intended to be of service in all cases where a first-class article is desired. It has a long reach, thus facilitating its use on roads which have long transfer tickets, and the open sight permits the conductor to operate it



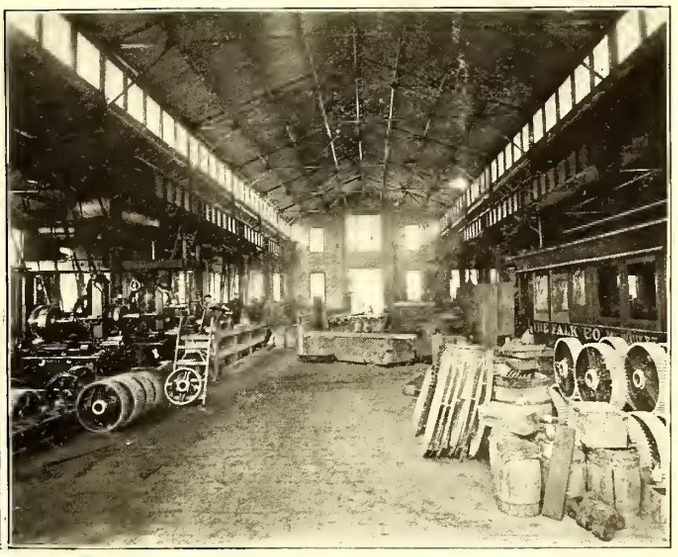
IMPROVED PUNCH

quickly and accurately. The dies are of hardened tempered steel, which gives good results after long wear. This punch is one of twenty-five styles made by the Cincinnati Manufacturing Company, Cincinnati, Ohio. The design is new, but wherever introduced has given satisfaction.

The New Plant of the Falk Company

Most readers of this paper will remember the announcement that appeared in the JOURNAL considerably over a year ago, stating that the works of the Falk Company, at Milwaukee had been completely destroyed by fire. The company immediately began the erection of a new plant, work upon which was retarded considerably by the difficulty in securing material. The new works are located in the Menominee Valley at the foot of Thirtieth Street, some twenty minutes' ride from the heart of the city. Beside the office building, there are three large separate buildings, the foundry, machine shops, blacksmith shop and power house.

The office is a model of convenience, comfort and elegance; the entire interior being built of hard wood, and furnished throughout, desks, chairs, tables, etc., etc., of golden oak. It is equipped with a fire proof vault, toilet and wash rooms, a shower bath, private rooms for the various members of the company, and a directors' room.



VIEWS IN THE WORKS OF THE FALK CO.

The first building next the office is the open hearth steel foundry. It is of steel and brick, the same construction being used for all the buildings. The foundry is 100 ft. x 200 ft., one end being boarded up temporarily, allowing for extension at any time. The foundry is equipped in every department with the most modern apparatus, including a Wellman-Seaver tilting furnace, which has many advantages over the old style of stationary furnaces. Steel is made by what is known as the acid process, which produces castings which are perfect as regards finish, free from blow holes and other defects. Two, 25-ton with 5-ton auxiliary hoist, each, Pawling & Harnischfeger cranes are in use. The foundry has a capacity of about 50 tons per day, and is equipped to handle castings from 30 lbs. to 35,000 lbs. each. The cleaning apparatus is of the most improved kind, and designed by members of the company. The Falk Company takes particular pride in its ability to turn out castings which have troubled other founders, and has already gained an enviable reputation for this class of work. The company makes all its own gear castings, of which it is a large manufacturer. This gives the advantage of being able to secure uniform material and that best suited to this particular line of work. These gears are all made with specially constructed flasks, as well as other apparatus; the methods employed are such as to produce castings absolutely free from blow holes and true to pattern. Since the foundry was started not a single casting has been discarded on account of developing blow holes, which indicates the uniform quality of the Falk gears.

A specialty is also made of castings for steam railways, castings for engine and cars, and knuckles for coupler repairs, the latter being produced by the thousands.

All iron and steel used in the various departments is analyzed in the company's own laboratory, fitted up in one corner of the foundry. This is all bought on a specified analysis, and if any is not found strictly up to specifications it is rejected. A competent chemist devotes his entire time to this work.

The machine shop is also 100 ft. x 200 ft. It has every modern appliance for the manufacture of gears and pinions and special work. All machines are driven by motors, either directly connected or bolted, so that one motor drives a group of two to four machines. The latter ones are placed on an overhead platform, running the entire length of the shop. All are driven from a generator in the power house. An interesting corner under this roof is that of the inspection department. Here every gear and pinion passes a rigid test for errors in dimension or flaws in material, with the result that the Falk Company has no shipments returned from dissatisfied customers.

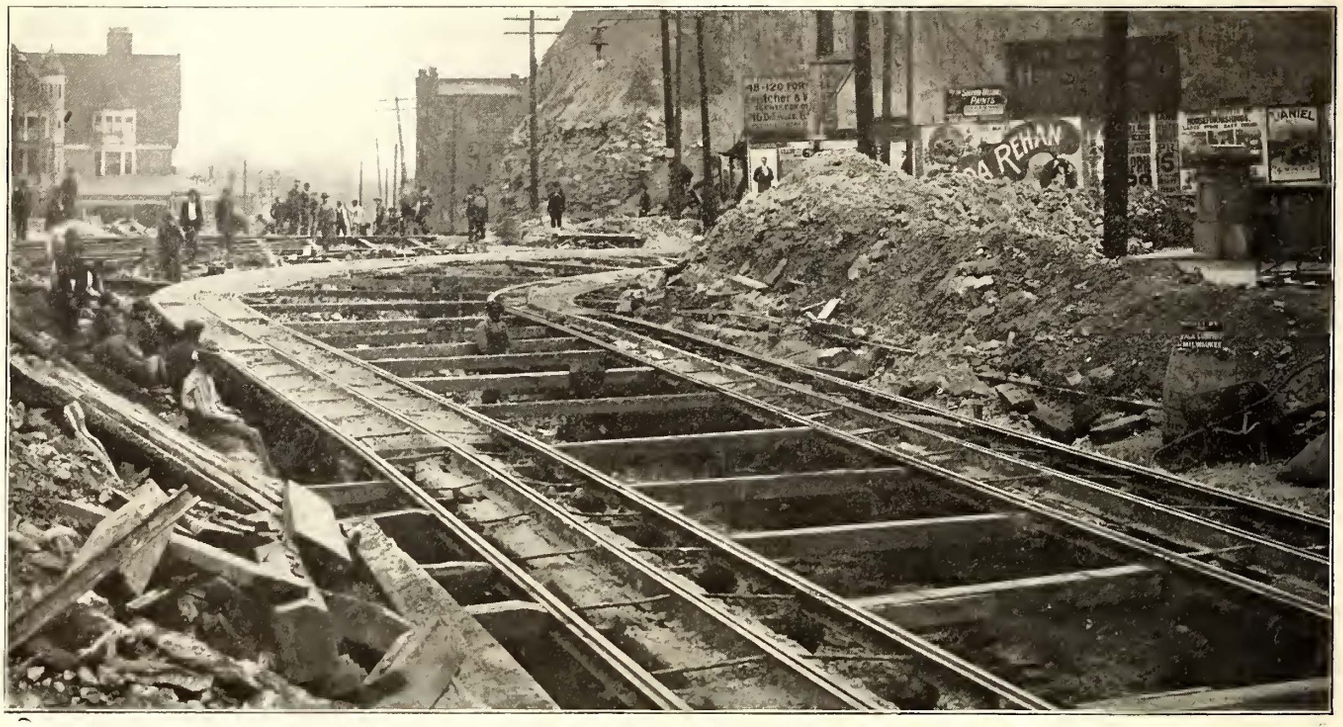
Back of the machine shop is a large platform for laying out special work; here also are the sand and stock sheds and pattern building. Beyond the machine shop is the building containing the blacksmith shop and power station. Here are made all pinion forgings, used by the company; these are made from open hearth steel billets, of high carbon, which is found to be the very best grade of material suitable for this work. The pinions are made from individual forgings, which are hammered thoroughly to produce a very close grain and hard metal.

The engine room, in one end of this building, has a 250-hp horizontal Allis Corliss engine, belted to a 220-volt 150-kw. General Electric generator. The switch board has Cutter circuit breakers, and Weston instruments. The boiler plant consists of three 80-hp tubular boilers. The shops are heated with hot air.

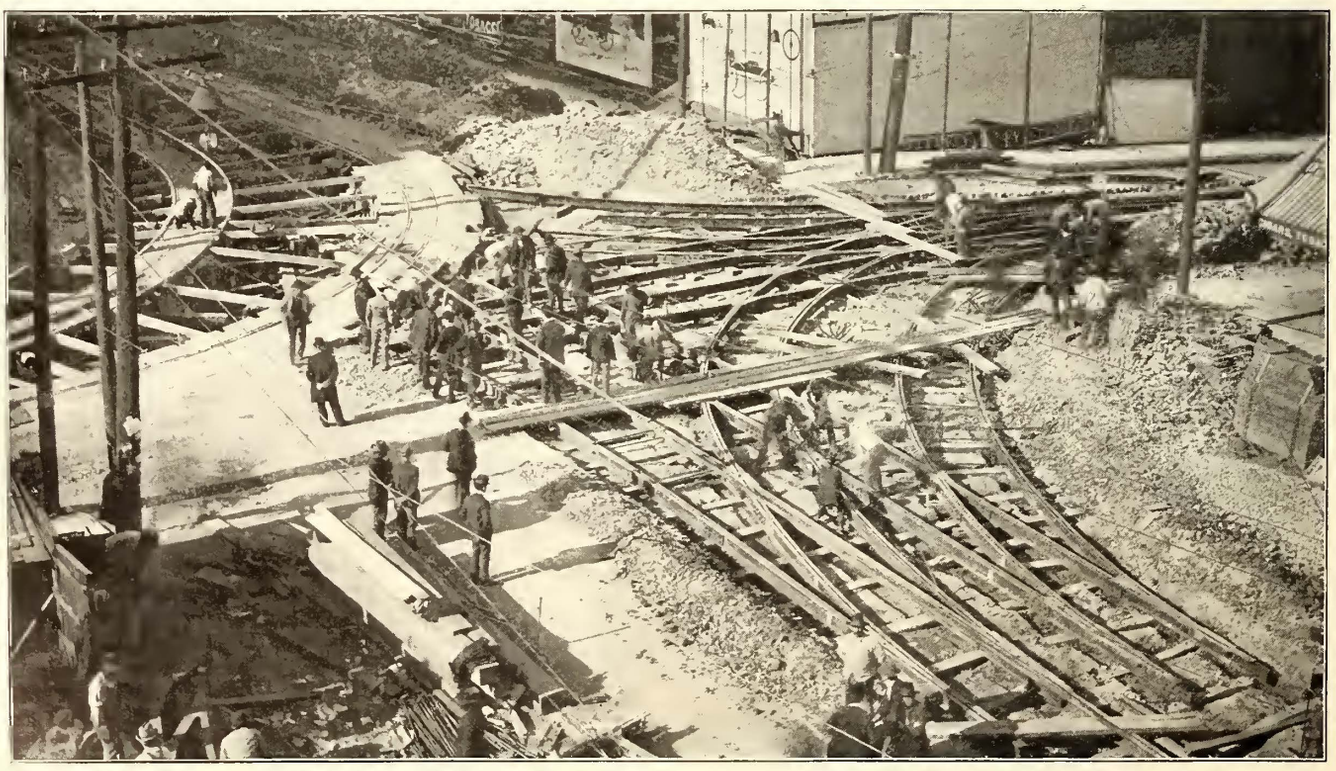
The factory's railroad facilities could hardly be improved upon, as switches from the C. M. & St. P. R. R. run through each shop building, and bring material to the yard outside.

The Falk Company was organized in 1894, under the name of The Falk Manufacturing Company, and introduced upon the market the cast-welded rail joint, upon which the company owns all the original letters-patent, and which it is at present vigorously defending against all infringers. When this joint was first brought out, it was accepted with a great deal of hesitancy by street railway men and engineers, but actual practice has long since demonstrated its success, and it is now standard construction on all roads throughout the world. The Falk Company has welded nearly 1,000,000 joints.

At the suggestion of railway men, for whom the company was already doing work, the manufacture of special work was taken up, and this department has grown until the Falk Company is now



CONSTRUCTION WORK AT KANSAS CITY



COMPLICATED CURVE AT KANSAS CITY

one of the largest special work manufacturers in the country.

In commencing the manufacture of special work, the company secured the services of a competent corps of engineers, and began the construction and complete equipment of electric street railways. The company has an excellent organization for this class of work, and takes a great deal of pleasure in pointing to such work as that done for the Citizens' Traction Company, Oshkosh, Wis.; the building of the Interurban Railway between Oshkosh and Neenah, Wis.; the reconstruction of the lines at Davenport, Ia., Decatur, Ill., and Kansas City, Mo. Of this latter work, upon which the company has been employed for the last two seasons, it is especially proud. Here the company has recently accomplished one of the most difficult engineering feats met with in street railway construction. The problem was to change the double cable track on Grand Avenue between Eighth and Ninth Streets, which was one compound curve, extending the entire block, to simple curves at Eighth and Ninth Street corners with straight track connecting. This necessitated moving both tracks bodily, several feet to one side of the old location. The operation shortened the track to the extent that the cable itself had to be shortened twice during the progress of the work. The headway between trains at this point does not exceed two or three minutes, which made the work extremely difficult and dangerous. Thus far there has not been the slightest obstruction to traffic, nor a single accident, and the work is practically finished, notwithstanding the fact that the feat was considered by even the street railway company itself, as practically impossible.

Considering the short time it has been in existence the Falk Company has had a remarkable growth. This is due to the honesty of its work and products, coupled with courteous treatment towards all of its customers, who can be found in almost every street railway town, not only in America, but of Europe as well. Its foreign shipments number many tons of material a month, and its cast-welding outfits can be found in many places on the continent.

The officers of the company are Herman W. Falk, president; Otto H. Falk, vice-president; E. A. Wurster, secretary and treasurer; Clement C. Smith, second vice-president; Adolph Quentin, third vice-president; C. L. Jones, assistant secretary; W. Frank Carr, chief engineer.

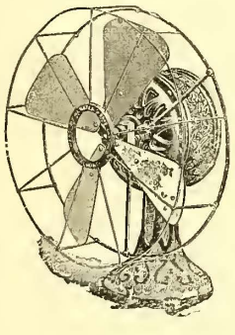
WORKS OF THE FALK CO.

Electric Fans

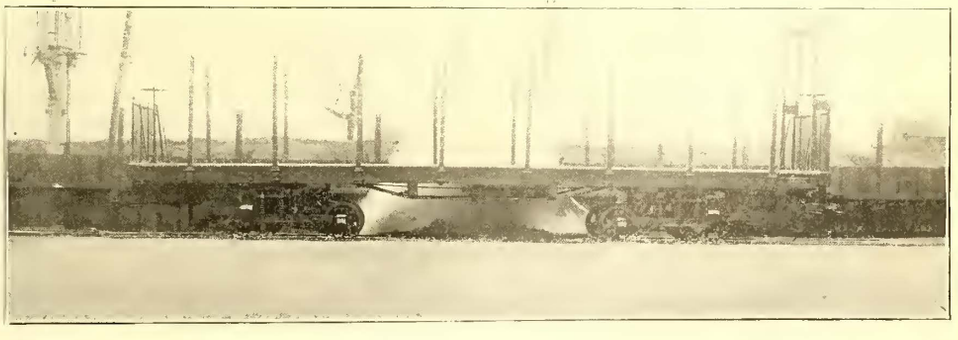
As the summer is approaching the question of motor fans becomes again of importance, and that this is of interest to electric railway companies as well as to companies distributing electric power for miscellaneous purposes is shown by the fact that a number of fan manufacturers build fans for 500-volt circuits. The desk fan illustrated herewith is from the factory of D. L. Bates & Brother, located at Dayton, Ohio. This concern is not new in the business, having been engaged in the manufacture of electric fans for the last nine years, and it reports an increasing demand for its product. While the types of fans are somewhat familiar, various improvements have been made both in mechanical construction and in the efficiency of the motors. The fans are finished in nickel, oxidized copper, polished brass and Japan.

Freight Car on Maximum-Traction Trucks

The accompanying illustration represents a novelty which may be of interest to street railway men and others. It is nothing less than a 30-ft. freight car, mounted on maximum traction trucks. It was built by the J. G. Brill Company for the Winston Road in North Carolina. At one end are four posts which carry the trolley pole. Both ends are fitted with dashers and brake wheels. The car is of the regular steam gondola type, with truss rods and needle beams, stake pockets and stakes running along the sides. The body was made as low as practicable, and is 7 ft., 6 ins. wide at the sills. There are two G. E. 58 motors. The trucks have a 4-ft. wheel base, the wheels being 33 ins. in diameter, with 3-in. tread and 5/8-in. flange. The gage is standard.



ELECTRIC FAN



ELECTRIC FREIGHT CAR

CURRENT NEWS

Syracuse Mutual Benefit Association

The Mutual Benefit Association of the Syracuse Rapid Transit Company, is one of the strongest organizations of its kind in the country, and has a membership of 250, out of about 350 employees. A large number of those who are not members now are ineligible on account of age. The organization has rooms fitted up in the Gridley Block, and they occupy nearly the entire top floor. The association is a combined pleasure and benefit organization, and pays $1 a day during a member's sickness, and $150 when a member dies. The rooms of the company are laid out after the style of other similar organizations, and are supplied with billiard tables, etc., for the amusement of members. On May 14 the membership was increased by the initiation of about 100 new members. On this occasion the board of trustees served a repast, and an enjoyable evening was spent. From present indications the association will soon have a very handsome reserve fund.

Bridgeport Traction Company's Employees' Association

The employees of the Bridgeport Traction Company organized the Bridgeport Traction Company's Employees' Association on June 22. The organization has a membership of 50, and it is expected that this will be increased to 150. The new organization is planned after, and will follow the lines of the Mutual Benefit Association, of the Syracuse Rapid Transit Company. It will pay both sick and death benefits, and will shortly fit up club rooms where members will be entertained. The officers of the organization are: President, Thomas Burke; vice-president, William Killeen; financial secretary, Robert McCullough; recording secretary, Edward McCormack; treasurer, Howard Miller. A committee on by-laws was appointed as follows: Harry Daunt, chairman; Frank Riley, John Lynch, Henry Bain and Charles Neadles.

New Air Cars in New York

The Metropolitan Street Railway Company has just received from the Compressed Air Company the first of the perfected type of air motors intended for service on its Twenty-eighth and Twenty-ninth Street crosstown lines. The present old style air motors will be withdrawn from service on Twenty-eighth and Twenty-ninth Streets, and horse cars temporarily substituted so that the present car bodies can be fitted with the improved type of air motors. Meanwhile the line is being relaid with heavy steel rails. The new motors are the first of the 125 motors the Compressed Air Company is under contract to build for the Metropolitan. The motors are of improved and perfected design, obviating objectionable features and of increased power and economy.

Transfers in Baltimore

The United Railways & Electric Company, of Baltimore, Md., will, after July 1, give transfers on all its lines. Some time ago the transfer system was partly abolished on account of the abuse it received from the traveling public, but it is thought that under the new system the passengers and railway company will both be satisfied. Transfers will be given at all points of intersection except those points at which the passenger could take a car returning in the same general direction from which he had come or those which mark the terminus of one of the various lines.

Suits Against the Chicago Elevated Railroads

James R. Walker and the executors of the will of W. D. Walker have begun suit in the Superior Court against the Union Elevated Railroad Company for $250,000, and against the Union Consolidated Railway Company and the Union Elevated Railroad Company for $150,000, as damages. L. Z. Leiter is plaintiff in a suit against the Union Elevated Railroad Company and the Union Consolidated Elevated Railway Company for $1,000,000, and in one against the Union Elevated Railroad Company and the Northwestern Railroad Company for $100,000 as damages. The Union Elevated Railroad Company is also made defendant in suits begun by Thomas Murdock and Byron L. Smith and Ezra J. Warner, trustees under the will of Simon Reid, who asks damages in the sum of $150,000. The damage to the property is caused, it is alleged, by the construction and operation of the roads in the vicinity of the buildings owned by the plaintiffs. The plaintiffs and the amount of damages sought in still other suits are James Oliver for $150,000, against the Union Elevated and the Union Consolidated Railroad companies, and William C. Lebenstine, for $250,000 and $50,000, against the Union Elevated and the Northwestern Elevated Railroad companies.

Organization of Employees' Club at Camden

On Monday evening, June 11, an interesting gathering of the employees of the Camden & Suburban Railway Company of Camden, N. J., was held at the new car house, Newton Avenue, near City Hall, at which time a room was presented by the management of the company for the use of the employees as a recreation and reading room. The room has been provided with conveniences, nicely furnished with chairs, tables, black board and hat racks. A large number of popular magazines and technical journals have been subscribed for. The room was presented by Walter E. Harrington, general manager, and accepted on behalf of the employees by Samuel Holmes, one of the company's oldest employees. In presenting the room and describing among several of the purposes for which the room would be used, the following novel plan was proposed: To set aside one night in each month to be called "discussion night," at which time a subject would be selected of interest to the employees, relating to some subject in connection with the operation of the road; a committee chosen among the men to investigate, test and otherwise make an elaborate report to be read at the following meeting, and to be open for discussion by the employees and others interested; the full proceedings of the meeting to be taken stenographically and edited, in order to be kept on file. In connection with the above the social side is to be provided for. The employees voted a resolution of thanks, to be presented to the company, and a committee was appointed by the employees, of which B. Bibighaus was chairman.

The subject of "brakes" has been selected for the next meeting night of the club, and a committee of five motormen has been delegated to make tests and determine the time and distance it will take to stop cars of different weights and sizes. The subject for the evening in August is "How to Handle Controllers."

It is the intention of the club to cover, not only matters of electrical interests, but also general operating problems. The employees have taken an enthusiastic interest in this plan, and the committee appointed to investigate brakes has already had a meeting.

PERSONAL MENTION

MR. W. D. SARGENT, general manager of the Sargent Company, Chicago, returned from Europe Saturday last, the 23d, after a two months' trip.

MR. CHARLES P. TOLMAN, of the Christensen Engineering Company, of New York, is in Manchester, N. H., superintending the work of equipping the large cars of the Manchester Street Railway, with air brakes.

MR. CHARLES A. WORTS, of Oswego, has been elected general manager of the Rome Street Railway Company, of Rome, N. Y., to succeed Mr. W. P. Brown, who resigned to accept a position as general manager of a steam railroad.

MR. PETER KLING has resigned his position as general manager of the St. Louis Car Company, to accept a similar position with the John Stephenson Company in New York. It is not known who will succeed Mr. Kling, as Mr. Kobusch, president of the company, is out of the city.

MR. ALEX. WILSON, who recently left the employ of the Hamilton, Grimsby & Beamsville Railway to become chief clerk of the Hamilton Street Railway Company, of Hamilton, Ont., was presented with a gold mounted silk umbrella, suitably inscribed, in recognition of the company's appreciation of his six years of faithful service on the Hamilton, Grimsby & Beamsville Electric Railway. The presentation took place in the company's office, Vice-President W. J. Harris making the presentation speech.

MR. GORDON ABBOTT has been elected to fill the vacancy caused by the death of Mr. Amos Breed, as president of the Massachusetts Electric Companies. Mr. Abbott is also president of the Tacoma Railway & Light Company, of Tacoma, Wash.

MR. S. W. CHILDS, of the J. G. White Company, of New York, has just returned from Perth, Australia, where he has been for the past eighteen months superintending the electrical equipment of the Perth Tramways. Mr. Childs made a host of friends during his stay in Australia, and was given a rousing reception previous to his return home. A farewell banquet was tendered in his honor at the Grosvenor Hotel, and it was attended by the merchants of the city, councillors and officers of the city, and contractors and employees of the Electric Tramways Company. During the toast, "The Guest of the Evening," Mr. Childs was highly complimented for his good work, and regret was expressed at his retirement from the service. Mr. Childs was the recipient of two purses of sovereigns, one from the merchants, contractors and officers of the Council, and one from the employees of the Tramway Company. Mr. H. J. Somerset succeeds Mr. Childs.

NEWS NOTES

MIDDLETOWN, CONN.—The offices of the Middletown Street Railway Company were entered by burglars recently. It is not known how much the robbers secured.

BRIDGEPORT, CONN.—The Bridgeport Traction Company intends to inaugurate an express service on its line between Bridgeport and Woodmont.

HARTFORD, CONN.—The Hartford Street Railway Company has presented the Common Council with a petition for several extensions of its system. It is proposed to run a single track from the Barnard Park on Main Street through Park Street to Lafayette Street, and to lay a single track from Zion Street to Laurel, thus making a through track from Main Street through Park Street to Prospect Avenue. Another line of single track is to run from Main Street through Capen Street to its junction with Barbour Street and thence to Keney Park. Another extension is a double track from Barnard Park south through Maple and Franklin Avenues to the Wethersfield town line.

CHICAGO, ILL.—Charles L. Bonney, as counsel of the Chicago General Railway Company, has submitted to the reorganization committee a plan for the proposed reorganization of the road. He says that by continuing the receivership for about a year the assets of the company can be collected, the floating debt paid and the property returned to its stockholders.

CHICAGO, ILL.—Through the kindness of President Roach, of Chicago, the Union Traction Company, who donated the use of two electric cars, 150 women and children of St. Elizabeth's Social Settlement were given an outing from the settlement house, June 22.

CHICAGO, ILL.—Lawton C. Bonney, shareholder of the Chicago General Railway Company, has brought suit for $125,000 damages against John A. King and John H. Witbeck. The latter was for a time president of the company. The suit is based on the allegation that the defendants conspired together to injure the credit and business of the plaintiff. During May suits on notes for an aggregate of $125,000 were brought against the Bonneys, Lawton C. and Charles L. Bonney, by John H. Witbeck. These actions were on notes signed by the Bonneys, which Witbeck declared were due to him. L. C. Bonney asserts the notes had been paid by Witbeck with funds from the assets of the company. John A. King, co-defendant with Mr. Witbeck, is president of the Fort Dearborn National Bank.

NEW ORLEANS, LA.—The lower branch of the Louisiana Legislature passed an act June 26 to compel separate and equal accommodations for blacks and whites on street car lines. It is believed that the Senate will pass the measure.

BOSTON, MASS.—On June 28 Governor Crane signed the bill to compel street railway companies to vestibule their cars.

AMHERST, MASS.—Electric and steam railway interests are in conflict here. The Boston & Maine Railroad has applied for an injunction to prevent the Amherst & Sunderland Street Railway Company from continuing to cross a bridge over the Boston & Maine here.

BOSTON, MASS.—It is expected that the overhead division of the Boston Elevated Railway Company will be in operation by Jan. 1, 1901. But for delays in receiving deliveries of materials on contract the division would have been in operation Oct. 1.

RUTHERFORD, N. J.—W. C. Giles, president of the Newark & Hackensack Traction Company, swore out a warrant for the arrest of Captain Addison Ely, president of the Bergen County *Herald* Publishing Company, and Henry H. Copeland and Edward J. Luce, of the law firm of Copeland, Luce & Kipp, on June 20, on a charge of conspiring to publish a libel against the Traction Company. The libel complained of was published in the Bergen County *Herald*, and Mr. Giles already has suits pending against Captain Ely and the newspaper, in which he asks damages of $50,000.

NEWARK, N. J.—The North Jersey Street Railway Company has adopted an ingenious device to save the passengers in its open cars from the consequences of poking their heads out of the car where they are likely to get in the way of any vehicle on the other track. On the side of the cars facing the opposite track the company is putting in, above the side-bar and on a level with the passengers' heads, a light wire grating about 18 ins. wide. To get his head outside of this a passenger must either lie down on the floor and crawl underneath the grating or stand on the seat and lean out near the roof. The screen is transferable to either side.

ROCHESTER, N. Y.—The employees of the Rochester Railway Company held their first annual outing on June 25, at the Island Cottage, Buck Pond, on the Manitou Beach Railway. It is estimated that 200 employees were able to be at the picnic. Athletic sports were indulged in, and a game of baseball was played. A number of officials of the company were at the picnic. Among them were Treasurer Moorehouse, General Manager Nicholl and Superintendent Hicks.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Company proposes to equip its cars with illuminated destination signs in the near future.

NEW YORK, N. Y.—The proposed hearing on the application of the Metropolitan Street Railway Company for a street-car franchise in Elm Street, before a joint committee of the Municipal Assembly, has been postponed indefinitely.

BROOKLYN, N. Y.—Two young women were struck by a car of the Brooklyn Rapid Transit Company on the Coney Island Creek Bridge at 1:30 o'clock on June 21 and instantly killed.

NEW YORK, N. Y.—Justice Bischoff, in the Supreme Court, by consent of the lawyers, adjourned until July 9 the arguments on the application of the Manhattan Railway Company to continue the injunction to restrain the Park Board from interfering with its elevated structure in Battery Park.

SYRACUSE, N. Y.—Attorney-General Davies has reserved decision after listening to arguments on an application of Samuel Ferguson for the beginning of an action to annul the franchises of the Syracuse & Oneida Lake Electric Railway Company, made on the grounds that it has failed to construct its road within a year after having obtained the required consent from the authorities of the towns through which it proposes to pass.

UTICA, N. Y.—The Utica Belt Line Street Railroad Company has voluntarily increased the wages of its employees. The following bulletin, posted on the bulletin board at the depot June 25, announcing the change: "Utica, June 25.—Commencing July 1, 1900, conductors and motormen during the first year of their employment will receive 14 cents an hour; between one and five years, 15 cents an hour, and over five years 16 cents an hour. Conductors and motormen who shall have been continuously in the employ of the company for five years will be entitled to wear two service stripes on the left coat sleeve of the regular uniform, which should now be obtained, the conductors' stripe gold and the motormen's silver, and one additional stripe to be added for every additional five years. John W. Boyle, president." There are just 127 men who will be affected by the order, which is the second one announcing an increase of wages within a little over a year. The present wage rate is 13½ cents an hour to conductors and motormen during the first year of their employment. The new order increases it to 14 cents, an increase of half a cent an hour. Conductors and motormen who have been in the service of the road over a year are now earning 14 cents an hour. There is a new arrangement under the new order which will have a tendency to make the employees desire to continue in the employ of the road permanently. Employees who have been on the road over one year will, after July 1, receive 15 cents an hour, and those who have five years to their credit will receive 16 cents an hour.

TOLEDO, OHIO.—The Toledo Traction has just prepared for gratuitous distribution a very neat folder on Toledo. On one side of the folder is a bird's-eye view of the city, showing the principal lines of the street car system, various points of interest in and about the city, Lake Erie Park and Casino, and lastly a diagram and bird's-eye view of the Ohio Centennial grounds. On the reverse side is a brief history of Toledo, something about the location and industries, its population and its wealth, considerable data regarding the street car system, and lastly a history of the Ohio Centennial to date.

SPRINGFIELD, OHIO.—The suit of S. L. Nelson against the American Railways Company, in which the plaintiff asks for $70,000 commissions for the negotiation of the deal by which the company purchased certain street railway properties in Dayton, has been removed to the Federal Courts, at the request of the defendant.

COLUMBUS, OHIO.—A resolution was adopted by the Board of Public Works a few days ago, declaring void the franchises held by the Columbus Railway Company as successor to the Columbus & Westerville Electric Railway Company. The original franchises covering a number of important streets were granted in 1894, and, although the time limit has been repeatedly extended, the roads were never built.

HARRISBURG, PA.—Writs of quo warranto were issued June 22 by Judge Simonton, at the instance of Attorney-General John P. Elkin, against the following street railway companies: Washington & Belle Vernon, Belle Vernon & Fayette Street, Fayette County & Belle Vernon and North Belle Vernon, requiring them to show cause by what authority they claim to have and use the rights and processes, privileges and franchises of such corporations. These companies were chartered by the State, Dec. 12, 1899, but since that period no railway has been constructed or operated upon any part of the routes mentioned in their charters, by reason of which the rights of these companies to exist as corporations have become forfeited to the commonwealth.

PITTSBURGH, PA.—On June 26, George W. Stern, of New York, filed two suits in equity in the United States Circuit Court against the directors of the Consolidated Traction Company and the Union Traction Company, consisting of C. L. Magee, Joshua Rhodes, B. F. Jones, T. H. Given, George I. Whitney and John A. Bell, of Pittsburgh. Stern prays for an accounting of dividends paid in excess of earnings of the company as dividends on preferred stock, and that they be particularly ordered to pay the treasurer $360,000 paid out after notice of dividend No. 6; that defendants be ordered to repay the Consolidated Traction Company amounts unlawfully received by them, purporting to be paid as dividends, and also that a receiver be appointed. Stern claims to be a holder of 500 shares of common stock. The case will come up in the November term of court.

PITTSBURGH, PA.—The Consolidated Traction Company has awarded a contract for 42 miles of feeder cables. The new cable will be used largely to supply current for the operation of several extensions now under construction.

KENOSHA, WIS.—At a meeting of the City Council, June 25, the Haynes-Clausen Street Railway franchise was passed to its final reading. The franchise carries a resolution attached demanding that the promoters file a satisfactory bond within seven days with the Northwestern Loan & Trust Company, of Kenosha, indemnifying the property owners on three paved streets for 7 ft. of paving. The franchise calls for a through and local line, which will form the completion of the electric system between Milwaukee and Chicago, when the line shall have been extended through to Waukegan. By the conditions of the franchise they are bound by $60,000 more for the performance of their contract. The franchise promoters are P. F. Haynes and G. L. Clausen, of Chicago.

MILWAUKEE, WIS.—The Wisconsin Supreme Court has denied the application of the Milwaukee Electric Railway & Light Company for permission to build under the franchise granted by the Mayor and City Council last January. This decision will keep the original injunction granted by Judge Ludwig in force, and will prevent the company from proceeding with the construction of any of the lines until a verdict is rendered by the Supreme Court.

TORONTO, ONT.—The employees of the Toronto Street Railway Company have formed a new court of the Independent Order of Foresters and named it the "Electric." The initial membership of the organization is eighty members.

MONTREAL, QUEBEC.—Considerable comment is said to have been caused in Montreal municipal circles by the application from the Montreal Terminal Railway (the old Belt Line) to continue its service through the city. The application was referred to the road committee of the City Council, and will probably be resisted by the Electric Street Railway Company on the ground, frequently urged heretofore, that the granting of such permission would be a violation of the contract between the company and the city. However, legal opinions have been given to the effect that under its contract the street railway company has no monopoly of the city streets. It appears that if the Terminal Company obtains the desired permission it will construct one or two electric car lines from one end of the city of Montreal to the other, connecting with its suburban system in the east end of the island. Some time ago this company endeavored to make arrangements with the Street Railway Company to run Belt Line cars to the center of the city or to lease special cars of its own connecting the Belt Line suburban service with the center of the city. This being refused, the Terminal Company now seeks to build city lines of its own, as it is empowered to do under its charter from the Dominion Parliament.

MONTREAL, QUEBEC.—A most extraordinary thing occurred in the Canadian Senate recently, almost without a precedent. The Buffalo Railway Company's bill, which was framed to enable it to absorb all the electric railway lines between Buffalo and the mouth of the Niagara River on both sides of the line, had passed the railway committee of the House of Commons, received its three readings and also received the assent of the Commons, was sent up to the railway committee of the Senate. It was passed by that body and received its first and second reading in the Senate, which is usually tantamount to a bill being passed, but, on its coming up for third reading, which is usually only a formality, it was thrown out. The company was incorporated in New York, and this action affects the Cataract Power Company, Hamilton Electric Street Railway, the Hamilton & Dundas Electric Company, Hamilton, Grimsby & Beamsville Electric Railway, Hamilton Radial Electric Railway, Galt, Hespeler & Preston Electric Railway, Niagara Falls Park & River Railway, Buffalo & Niagara Falls Electric Railway, Niagara Gorge Electric Railway, Buffalo, Tonawanda & Niagara Falls Electric Railway, Buffalo & Lockport Electric Railway, Niagara Falls & Suspension Bridge Railway, Niagara Falls, Whirlpool & Northern Railway and several others, proposed, building or being extended.

CONSTRUCTION NOTES

PASADENA, CAL.—The board of directors of the Pasadena & Mt. Lowe Railway Company have called a meeting of its stockholders for Aug. 2, to vote upon the questions of increasing the capital stock from $400,000 to $600,000 and increasing the bonded indebtedness from $375,000 to $500,000 by a new issue of 500 4 per cent $1000 thirty-year gold coupon bonds, which are to be used in redeeming the present outstanding bonds and for betterments, extensions and re-equipment of the line.

HARTFORD, CONN.—T. C. Perkins, of Hartford, has made application to the Selectmen of Agawam for the construction of an electric railway between Springfield and the Connecticut State line. Mr. Perkins' petition calls for two locations, both beginning at the State line and ending at what is called the South End bridge at Springfield. One of these, however, goes around through the center of the town of Agawam, and the other goes up along the river road. The company prefers to have the latter granted, but will take the former if the people of the town prefer. It is the intention of the promoters of the new road to run a fast line between Hartford and Springfield, and they hope to make the trip in an hour and a half.

WABASH, IND.—Joseph T. McNary, general manager of the Logansport, Rochester & Northern Traction Company, which is to build a trolley line 101 miles in length, from Logansport to Kendallville, says work will commence on the grade of the road at Logansport July 4. The money for the construction work has all been provided, and but for the illness of the civil engineer in charge of the work operations would have commenced six weeks ago. One section of the road will be in operation by fall.

KOKOMO, IND.—It is said that a company, to be known as the Kokomo, Wabash & Lake Manitou Railway Company, is to be incorporated shortly. The company is being organized to construct an electric railway from Kokomo to Rochester via Greentown, Converse, Wabash, Roann and Akron. The right of way has been obtained along the entire route, and negotiations are now on for financing the road. Franchises have been granted in all the towns on the line, and the promoters are reported to have said that the enterprise is certain to go. The road will be about 60 miles long and traverse a populous and wealthy region.

FT. WAYNE, IND.—The Ft. Wayne & Butler Railway Company has been incorporated, with a capital stock of $50,000, to construct an electric railway from Ft. Wayne to Butler, a distance of about 40 miles. The directors of the company are Robert H. Carnahan, B. Paul Mossman, Robert Millard, William H. Olds, Charles W. Orr, Van B. Perrin and Frank L. Smick.

DAVENPORT, IA.—The Tri-City Railway Company is having a part of its system double tracked in the vicinity of Warren Street. B. F. Nickerson, of the Falk Company, of Milwaukee, Wis., has charge of the work. It is expected that the job will be completed in about a month.

AUGUSTA, MAINE.—The Gardiner & South Gardiner Electric Railway Company has filed a petition with the Railroad Commission for a location. It is proposed to connect the city of Gardiner with the village of South Gardiner. The road will form one of the connecting links in the projected system between Augusta and Portland.

SEDALIA, MO.—The receivers of the Sedalia Electric & Railway Company contemplate making a number of improvements in the street railway system. The power house on East Broadway is to be enlarged, and a new car house is to be built on East Ninth Street. The latter will be 120 ft. x 50 ft. The installation of additional power-house machinery is contemplated, and several new cars are to be purchased. The old cars are to be overhauled and refitted.

ST. LOUIS, MO.—The Wellston, Creve Couer & St. Charles Railroad Company has petitioned the St. Louis County Court to allow an amendment to its petition of April 9, which asked for a permit to lay tracks on the National Bridge Road. The amendment requests a private right of way.

KANSAS CITY, MO.—The Metropolitan Street Railway Company is rushing work on its Eighth Street viaduct, and expects to have it completed within six weeks. The total length of the viaduct is 650 ft., and is just wide enough for two tracks. Seven hundred thousand pounds of steel have been used in building it, and the largest of the big girders that have been used weighs 20,000 lbs. This great mass of steel and the concrete approaches made a solid and durable base. The foundation has been put down to bedrock—that of the west approach being 34 ft. below the street grade. In order to meet the demands of property owners that the structure should be sightly and impervious, the whole track space will be covered with steel plates over girders on which ties are laid imbedded in bituminous concrete. On top of the ties ducts will be laid, carrying feeder cables, the ducts being imbedded in and surfaced over with sheet asphalt, giving the viaduct from overhead the appearance of an ordinary double-tracked street railway on a paved street. Eighty-pound rails will be used on the viaduct, and a safety appliance will be provided by an inner and outer guard-rail and guard-rails at the approaches. Except at the Main Street station, the viaduct has an incline of 6 ft. to over 100 ft.

GREENSBORO, N. H.—The City Council has passed an ordinance granting the Guilford Power Company a franchise to construct a street railway in Greensboro. The franchise is for thirty years, and provides for a single-track system, with one exception. The price of transportation is to be 5 cents within the city limits and six tickets are to be sold for 25 cents.

MIDDLESEX, N. J.—The South Amboy Borough Council has passed an ordinance granting the Middlesex & Somerset Traction Company a franchise for the construction of an electric railway through the borough.

NEWARK, N. J.—The North Jersey Street Railway Company formally opened its new line on Jackson Avenue, Greenville, June 28.

NEWARK, N. J.—The North Jersey Street Railway Company has commenced the operation of cast-welding its track joints. The Falk system is being used, and a 1-ton cupola has been purchased, together with the right to use it without paying royalties. From ten to eighteen joints are cast per ton of iron, according to the size of rail, and both new and old rails are being welded. Work is being carried on every pleasant night, but it will be some time before the entire undertaking is finished.

ALBANY, N. Y.—The United Traction Company has awarded J. M. Jones' Sons' Company a contract for twenty-five cars.

CATSKILL, N. Y.—The Catskill Electric Railway Company has purchased the necessary poles, ties and rails for the construction of 2½ miles of its proposed road, and is in the market for other supplies. The work of construction, placing of orders for equipment, etc., is in charge of Fowler & Robert, the well-known supply firm, of 149 Broadway, New York. Mr. Robert states that all orders will be placed immediately, and the road will be finished as soon as possible.

NEW YORK, N. Y.—On June 21 the Rapid Transit Commissioners voted to change the route of the subway at the northern end of the West Side line, so that it will go north in almost a straight line over a viaduct from the portal of the tunnel at Hillside Avenue to the terminus at 218th Street via Nagle, Eleventh and Tenth Avenues, instead of making a detour to the west through Ellwood Street to Inwood. The change will save 1000 ft of viaduct and $100,000 in the cost of building. Contractor John B. McDonald approves the change because the new route will be through a more thickly settled section and will pay better when the road is in operation.