Street Railway Journal

VOL. XXVII. NEW YORK, SATURDAY, JANUARY 6, 1906. No. 1.

PUBLISHED EVERY SATURDAY BY THE

McGraw Publishing Company

MAIN OFFICE:
NEW YORK, ENGINEERING BUILDING, 114 LIBERTY STREET.
BRANCH OFFICES:
Chicago: Monadnock Block.
Philadelphia: Real Estate Trust Building.
Cleveland: Cuyahoga Building.
London: Hastings House, Norfolk Street, Strand.

Cable Address, "Stryjourn, New York"; "Stryjourn, London"—Lieber's Code used.

TERMS OF SUBSCRIPTION

In the United States, Hawaii, Puerto Rico, Philippines, Cuba, Canada, Mexico and the Canal Zone.

Street Railway Journal (52 issues).....$3.00 per annum
Single copies .....10 cents
Combination Rate, with Electric Railway Directory and Buyer's Manual (3 issues—February, August and November) $4.00 per annum
Both of the above, in connection with American Street Railway Investments (The "Red Book"—Published annually in May; regular price, $5.00 per copy).....$6.50 per annum

To All Countries Other Than Those Mentioned Above:

Street Railway Journal (52 issues), postage prepaid..... $6.00
25 shillings. 25 marks. 31 francs.
Single copies.....20 cents
Remittances for foreign subscriptions may be made through our European office.

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Of this issue of the Street Railway Journal 8500 copies are printed. The total circulation for the year 1905 was 424,350 copies, an average of 8160 copies per week.

The Prospects for 1906

At no period in the history of electric railroading has the future for a coming twelve months seemed so fraught with important developments as at the beginning of the present year. The industry, which was not even in existence twenty years ago, and ten years later had not emerged from the limitations which the use of direct-current systems of distribution entailed, now promises to gather a large number of the trunk lines of the country in its folds. This application of electric power to trunk line service, which has ever been one of the favorite ideals of the electrical inventor, now seems measurably within accomplishment. Certainly at no previous period has there been not only so much interest but so much actual work under way. The New York Central and Pennsylvania terminals in New York City were under contract a year ago, and were in a sense obligatory, as local conditions would not permit the use of steam power. This remark, however, does not apply to the plans of the Pennsylvania Railroad for its Atlantic City line, those of the Erie in Central New York, the electrification of sections of the West Shore Railroad by the New York Central, the Long Island Railroad work, or entirely to the plans of the New York, New Haven & Hartford Railroad, whatever they may actually be.

Turning now to interurban and city electric railway work, we find on existing roads rapidly increasing gross earnings as compared with last year, although expenses of labor and material are high—higher in fact than for many years past. Upon this fact certain managers have been disposed to take a somewhat gloomy view of the outlook. It may be that everything which goes into electric railway operation costs more than it did last year, while fares are no higher. We will admit as equally true that some lines have been built upon a mere speculative chance of traffic in regions where the population served would not justify the expense. That such roads have failed should occasion no surprise, but that the ordinary road, built at the present time with any regard to reasonable capitalization and traffic return, is likely to prove a bad investment, we are by no means ready to admit. In a term of years costs even themselves up, and if copper is 20 cents to-day it may be 12 in a few months. From a rational standpoint, a property which returns a good rate of interest on the money actually invested is financially sound. The country is growing more populous and richer every day, there is growing necessity for quick transportation, and people have the money to pay for it. Success means getting next to the people, and at the beginning of the new year, when the outcome during the next twelve months is foremost in the minds of all, it ought not to be out of place to refer to the keynote of success in management.

There is no other important business in which the receipts are in so small units derived from so many individuals. The one point in which consolidated systems are sometimes weak is in keeping the local situations in touch. The prosperity of a road depends absolutely upon keeping on friendly terms with the man with the nickel. The chap with the check book may get around to stockholders' meetings and kick, but he does not contribute much toward the dividends. It does no good to explain to the locally enraged that the management would be pleased to give better service if it could do so and still declare its dividend. Until the service is forthcoming the man with the nickel holds back unless spurred by necessity, and no amount of argument or advertising does any good. In spite of high expenses the road that stands closest to the popular interests will in the long run win prosperity in good times and in bad.

In this discussion of street railway conditions at the beginning of 1906, we might add a few words in regard to this paper itself. As in the past the STREET RAILWAY JOURNAL will endeavor to give to all of its readers the most accurate, prompt and best all around service possible. It will discuss all of the subjects—technical, financial, operating and commercial—

which affect the electric railway field, whether relating to city, interurban or heavy electric railroading. It will give equal attention to any possible substitutes for electricity, such as gasoline motor cars, which may prove efficacious for solving the problem of light interurban traffic. It will maintain its practice of treating the most important of these topics editorially, especially those which affect the operating force, and hopes to warrant the continuation of the favor which its readers have always accorded it in the past.

Annual Passes

Just at present a wave is sweeping over the railways of the country in favor of the abolition, or at least the restriction, of passes of all kinds. Both steam and street railway companies have definitely announced their intention of adopting this plan with the beginning of the new year. Among the former are the Pennsylvania, New York Central, Reading, Erie, Lackawanna and Lehigh Valley. Among the street railway companies which will enforce a similar policy is the Philadelphia Rapid Transit Company, which has discontinued all passes, except for officers and employees of the company, policemen and firemen in uniform and officials of connecting lines. In fact, in practically all cities where free transportation has previously been permitted in certain cases, a much stricter drawing of the lines will be enforced.

There is no doubt that there has been a serious abuse of the pass privilege in the past, and we heartily endorse any steps which may be taken to reduce or abolish it. The grant of a pass may often seem the easiest way to gain a man's friendship, because nothing delights the average American so much as the thought of getting something for nothing, and when the gift takes the form of a free use of a public service, it appears of much greater value than would its equivalent in money. The practice of companies in granting free transportation has differed radically in the past, from the plan under which no passes are given even to officials and employees, as on the Boston Elevated, to that which the road is mulcted to the extent of free rides by any politician who can make a successful strike on the officers. We believe that the system has been greatly abused in this country, and that the present is an excellent time to reduce it. If a railway company is strong enough to take an advanced position in the matter it is desirable to do so. If it should not seem best to cut off all passes, at least a step can be made in that direction.

The A. C. Railway Situation

In another column we are glad to be able to present a very thorough and careful review of the a. c.-d. c. railway controversy by Mr. Lamme, who certainly is able to speak from first-hand knowledge of the case, being no stranger to the various peculiarities of either type. In particular, he takes up the question of direct-current motors at high voltage which has been recently raised, and looking at the matter from a purely practical standpoint, calls attention to the fact that in spite of the great desirability of higher voltage for the sake of economical distribution, the actual working pressure has not been raised more than 100 to 150 volts in fifteen years of active railway development. Of course, a natural conservatism and the desire to use thoroughly standard apparatus is not without its bearing on this situation, but Mr. Lamme adds a plain statement of the somewhat serious difficulties involved in the design and use of d. c. apparatus for high voltage. He might well have added, that in spite of the voltage attained in some of M. Thury's constant-current machines their current capacity still remains very moderate. He also discusses, from the standpoint of a builder, the design of a satisfactory 1500-volt rotary converter, and points out very serious difficulties. The commutator problem in these machines is quite bad enough, even at the present moderate voltage. In addition, controlling apparatus for high voltage is rather serious business when large currents are to be controlled. Add to this the fact that even a 1500-volt distribution is only a palliative measure in long-distance working, and the difficulties of the situation are obvious.

One interesting feature pointed out by Mr. Lamme is that the measures required in designing a large a. c. motor for traction are of the very same kind demanded for successful d. c. working at high voltage. His article indicates, therefore, that so far as motors are concerned, the two propositions would be nearly at a stand-off, with the a. c. motors losing somewhat in weight efficiency and hysteresis, and gaining considerably in the simplicity of the control. As regards the general scheme of distribution, he declares there is no comparison, and once the transformer is located on the car, the voltage on the working conductors can be almost anything one pleases, even up to 15,000 or 20,000 volts. This is the commanding feature of a. c. traction, that the voltage on the trolley line is independent of the limitations imposed by the motor. One may, in fact, abolish the feeding system and connect the trolley wires directly to the high-voltage generators or the raising transformers. From an operative standpoint, the a. c. apparatus has the great advantage of having substantially no really inefficient speeds, such as affect d. c. apparatus in the passage from series to multiple connections. In the kind of electric railway work now most acutely needing attention, this gain does not rise to immediate value, but in the large field of railroad working its importance would be felt.

So far as efficiency and cost of equipment is concerned, Mr. Lamme takes a conservative position. One point to which he calls attention is the somewhat increased cost of single-phase generators over polyphase generators of the same output and characteristics, and the need of close regulation of the generators in case of a. c. operation. In the single-phase roads now installed the generator is generally a polyphase machine with all the phases in use on the various sections of the line; but how easily this arrangement could be used in the more general scheme remains to be seen. A pure single-phase generator costs something like 20 per cent more than a similar polyphase generator, so that the adaptation would be worth making.

So far as the general situation is concerned, our position has been many times stated. We have preached high voltage on the working conductors in season and out, until we began to think of ourselves as a voice crying in the wilderness. But the world does move, and improvements are coming rapidly. We hold no brief for the single-phase series motor—what happens to the energy after it reaches the car is from the wider view a minor consideration. If the series motor can best do the work, well and good; if it cannot, the polyphase motor is not dead yet, and the Leonard plan is by no means to be despised. But a voltage that will enable 500 or 1000 kw to be delivered from overhead-working conductors at long distances is imperative, if electric traction is to take the place which its friends hope for it. A thoroughly operative 1500-volt d. c. system is undoubtedly a step in the right direction, but after all a very short one compared to 15,000 volts, and

with the collection difficulty still to be dealt with. We do not, also, believe that the "third-rail system" is a finality in heavy railway work. It has been immensely useful in certain cases, and will continue to be so, but it is inferior to the trolley, and has been used only because it was necessary, on account of the very heavy currents demanded at our "standard" level of railway voltages. The vital question at this particular moment is whether the single-phase series motor can make good its claims in working on a large scale. Mr. Lamme's comparison of it with the high-voltage d. c. motor points out the nature of the difficulties that must be met. They are by no means trivial, either in theory or in practice. The next few months should throw considerable light on the situation. Only actual work on a considerable scale can be relied upon to settle the practical aspects of the matter. The main issue, that of high voltage, does not stand or fall by the success or failure of any particular type of motor.

San Francisco's Street Traffic Problem

Some time ago the Merchants' Association, of San Francisco, undertook to make an investigation of the transportation and street traffic conditions in that city and with laudable enterprise engaged William Barclay Parsons to go over the situation and recommend a general plan for the improvement and development of the city's street and transportation arrangements. Mr. Parsons made an exhaustive study of the problem and has presented his report, to which we devote considerable space in this week's issue. Topographically the conditions existing to-day in San Francisco are abnormal to those of any other city of the same size and importance in the world. The surface of the peninsula upon which the city lies is much broken by ridges and peaks, some of which rise to an altitude of 800 ft., and the commercial and residence sections have spread up and over these ridges and hills seemingly in direct defiance of grades and topographical obstacles. There are many rows of houses in the best sections of the city located on streets with grades in excess of 22 per cent and before whose doors there has never been a wagon. On these streets the delivery of everyday supplies and household requisites are made from the nearest cross streets above or below.

The persistency with which the residential sections have gradually crept up the slopes of apparently inaccessible hills has naturally created an enormous demand for transportation facilities whereby the hill residents can reach the business and commercial districts at the foot of the hills, but it has concurrently increased enormously the mechanical difficulties in the way of supplying this demand. Because of these grades San Francisco was one of the first cities to turn to cable traction as a solution for her transportation dilemma, and it has to-day a greater mileage of cable roads than any other city in the world. However, in comparison with the city's development, the limits and shortcomings of the cable have made themselves painfully evident, and all of the new lines that have been built within recent years, at least in the suburbs and in the less hilly sections, have been equipped for electric traction.

During the past five years the city has grown enormously in population and in business and commercial activity and it now faces the very serious problem of remodeling not only its transportation arrangements, but its general street conditions as well, or else the city stands in danger of seeing a considerable portion of its wealth and business interests pass to less important suburbs across the bay. These are the conditions that Mr. Parsons was called upon to investigate, and for which he was asked to recommend a feasible solution.

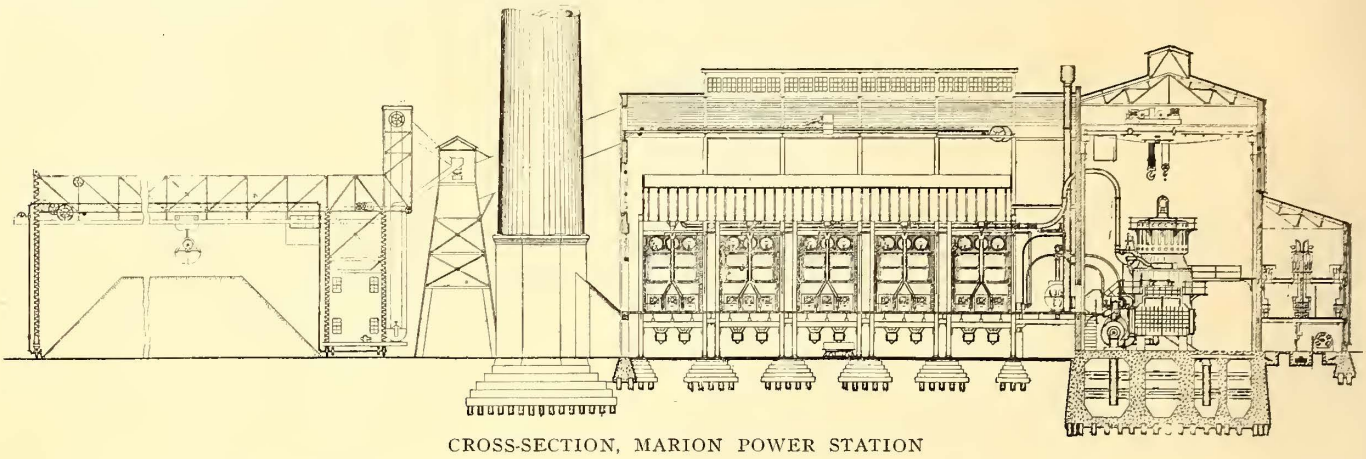
In a nutshell, the report aims to show that the cables are not as necessary to San Francisco as they have appeared to be. It unqualifiedly recommends that all present forms of motive power, including steam, horse and cable, be abolished, and that one system of electrical operation be adopted and made uniform throughout the city. Mr. Parsons further recommends that this system be the overhead-trolley. Because the Merchants' Association has heretofore stood firmly opposed to overhead trolley wires in business districts, Mr. Parsons takes pains to review at considerable length the history of the more important systems of electric traction, and particularly the development of the conduit system in New York and Washington. In urging against the adoption of the conduit he gives two most excellent reasons for his opinion; namely, that its introduction as a part of a growing system of railroads means the entrance of a new factor in operation and the destroying of uniformity, and second, the operation of the conduit is known to be both expensive and to involve the possibility of troubles and delays not present with the overhead trolley. He makes the statement that one-third of the delays on the conduit system in New York are due to accidents to the conduits. As an expert, thoroughly familiar with transportation development in this country and abroad, he was forced to conclude that the overhead trolley presents the only feasible substitute for cable traction on the street railways of San Francisco. Coupled with this recommendation, however, he advises the burying of all feed and transmission wires and the adoption of poles designed according to the highest artistic standards with arrangements to combine arc lighting with the overhead suspension of the trolley, so that one pole will serve for both purposes. In narrow streets where center poles are not possible he recommends attaching the wires to buildings by special ornamental rosettes. This is good advice and entirely in accord with modern experience that the presence of the overhead trolley in city streets should not and need not mean the disfigurement of the streets.

The report recommends substituting the trolley for the cable on all lines where the gradients are not in excess of 14 per cent, as this is taken as a safe limit for operation by electric traction. For the few lines that cannot be reduced to negotiable gradients the report suggests special solutions, which involve in one or two cases a change of the routes to adjacent streets, and in other cases tunneling under the peaks of the hills and carrying the overhead trolley through these tunnels. The tunnels would be reached from the surface by elevators and staircases. With the recommendations concerning the changes in transportation facilities an ingenious scheme is proposed for rendering the streets in the hill districts accessible to vehicle traffic. This includes the plan of terracing the streets so that the roadways will climb the hills by a series of winding inclines with easy gradients.

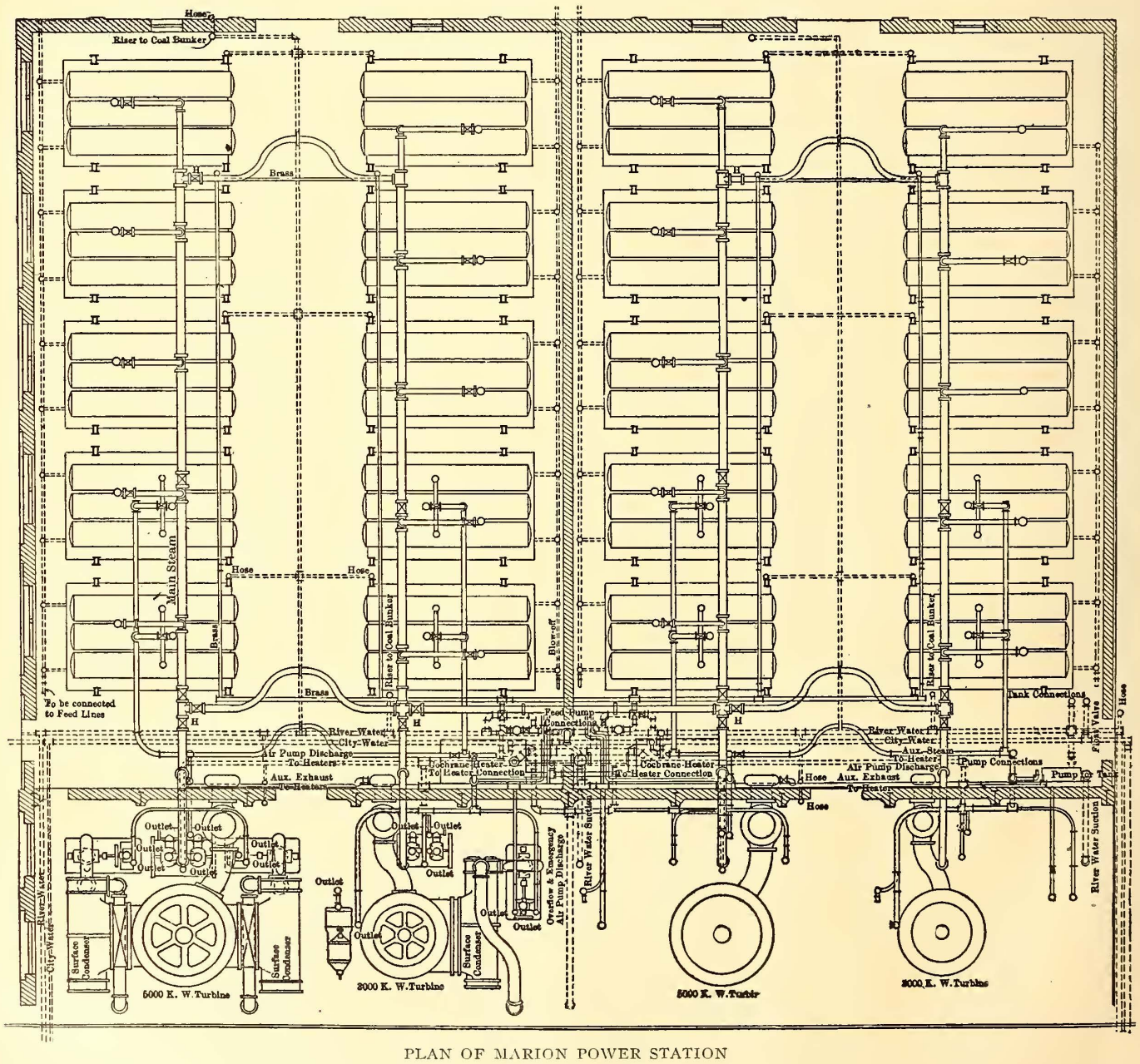
Because the Merchants' Association had set its heart on having the conduit system adopted in San Francisco and wanted Mr. Parsons to concur in this opinion, we regret to note from the newspaper reports that some of the gentlemen instrumental in securing his services are inclined to hold that they have been "gold bricked." It would appear that the only way in which to avoid the troubles such as Mayor Dunne and the gentlemen of San Francisco have brought upon themselves, would be, when public-spirited officials want information about transportation matters, they had better apply to experts who do know much about the subject.

POWER GENERATION AND DISTRIBUTION ON THE SYSTEM OF THE PUBLIC SERVICE CORPORATION OF NEW JERSEY—I

The Public Service Corporation of New Jersey, whose head offices are in Newark, presents a striking example of the tendency to merge public utility enterprises for the purpose of securing the benefits of single management and what might be termed single engineering. The Public Service Corporation now controls, through a long series of purchases and mergers, practically all of the electric lighting, power, gas and street railway utilities of the larger portion of the State of New Jersey. The benefits to the public in this instance have been many, resulting in lower rates for light and power, better street railway facilities and longer rides, and a far more reliable and dependable service in the supplying of electric light, power, gas and electric railway transportation.



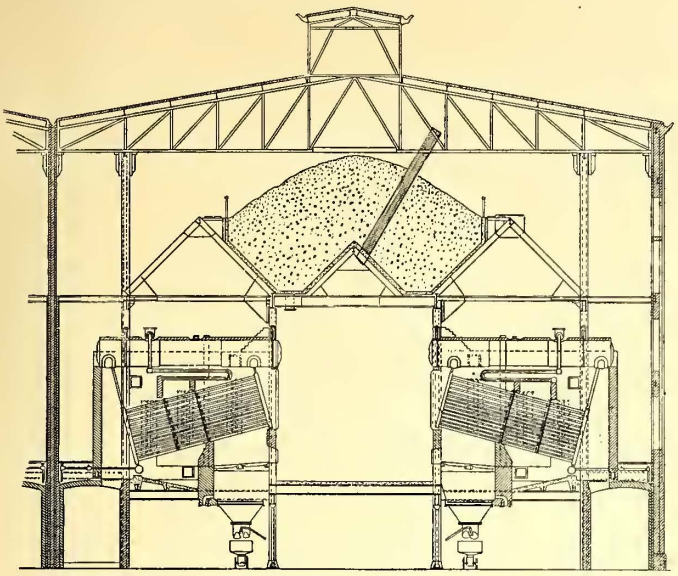
CROSS-SECTION, MARION POWER STATION



PLAN OF MARION POWER STATION

THE MARION (HACKENSACK RIVER) STATION

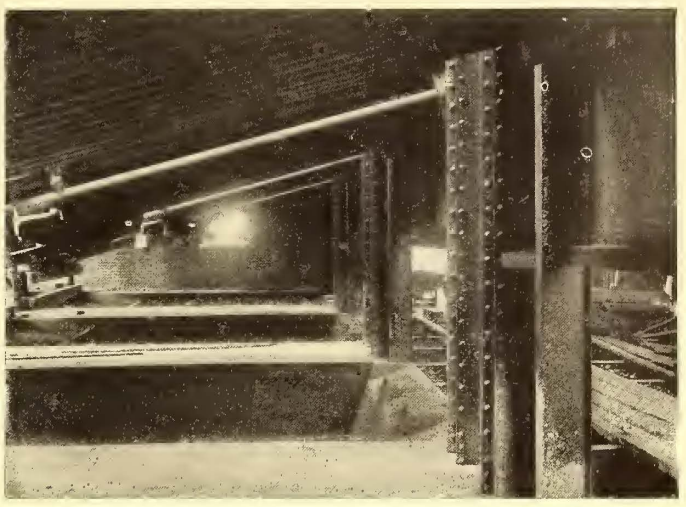
During 1903, in order to obtain increased power-generating capacity and also to secure a better arrangement of the then existing generating and distributing centers, the engineers of the company undertook the task of practically remodeling the entire power scheme, including the rearranging and discarding in part of some of the older stations that had been inherited by the parent company through the merging of the underlying properties; the establishing of new and more advantageous distributing centers; and the building of a new 13,000-kw power plant in the North Jersey section to care for the rapidly increasing business in this territory. This station is located at Marion, N. J., on the Hackensack River, where the corporation owns a tract of about 14 acres on the Hackensack Meadows between the river and a branch of the Pennsylvania Railroad. The Hackensack River gives excellent tide-water facilities for coal delivery in addition to direct connection with two steam roads.



SECTION OF BOILER ROOM, MARION STATION

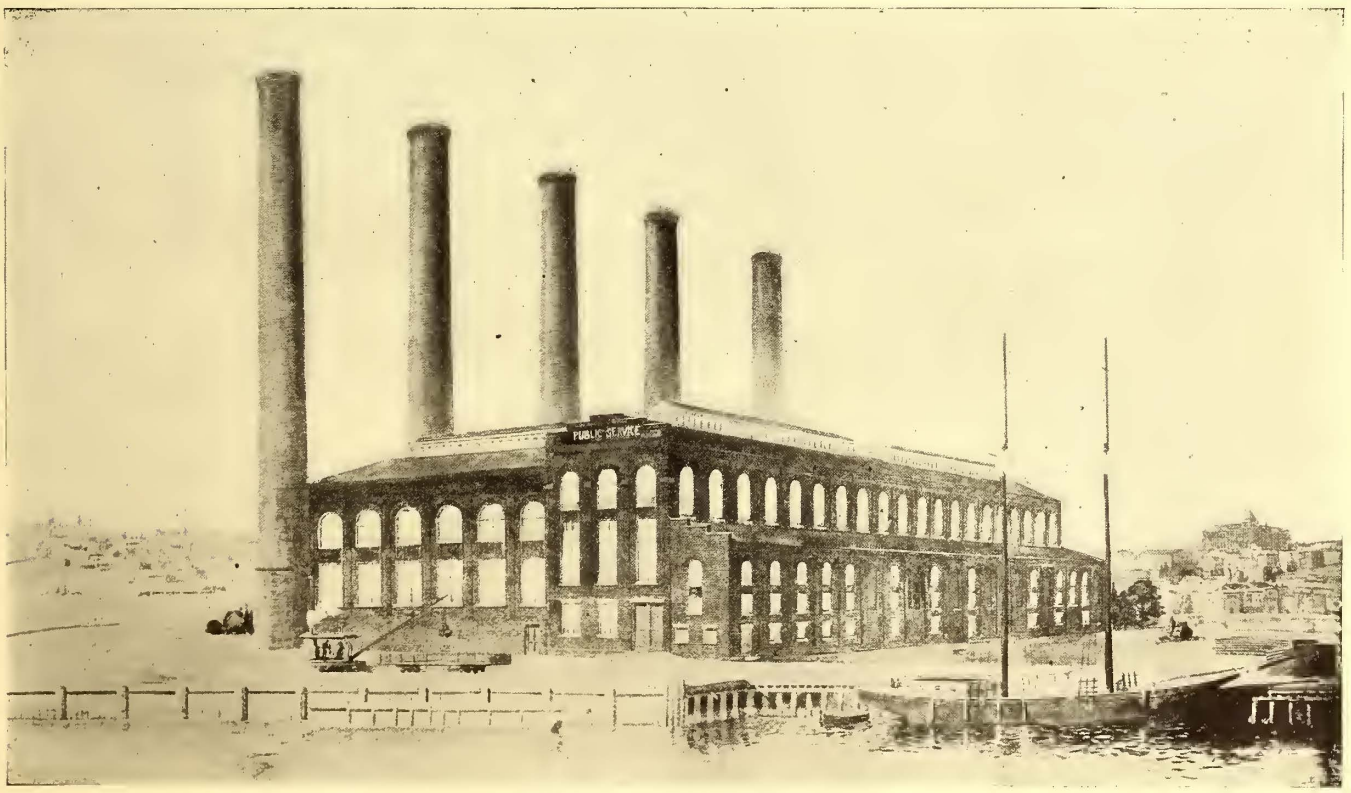
The station is well located with respect to the present central station and sub-stations and the districts to be supplied.

The building is substantial, though severely plain, no attempt having been made to gain architectural beauty. The walls are of red brick, except at the east end of the engine and switchboard building, where the wall is temporary and consists of corrugated iron laid on a light framework of steel. The engine room walls are lined to a height of about 20 ft. with white enamel brick, and for the rest of the height with a light buff brick.



FLAME PLATE AND ASH-PIT BELOW BOILERS

The boggy nature of the soil required care in the construction of foundations, which were built on reinforced concrete caps laid upon 3-ft. piling.



EXTERIOR MARION STATION

The engine room is 43 ft. x 150 ft. The boiler house is in two complete sections with a brick wall partition, and the two rooms together are 150 ft. x 115 ft. The switch and cable building is in reality a lean-to against the engine room wall and contains also the engineer's office. This addition is 21 ft. x 150 ft.

The generating equipment comprises two 5000-kw, 13,200-

volt, 25-cycle, three-phase, and one 3000-kw, 13-200-volt, 60-cycle, three-phase, General Electric Curtis turbo-generators. Provision for an additional 3000-kw unit is made in the present engine room. At the bottom of the vertical turbine shafts there are bearings adjustable in a vertical direction, and the thrust of the revolving shaft is taken by a film of water constantly supplied by a pump at a pressure of about 800 lbs.

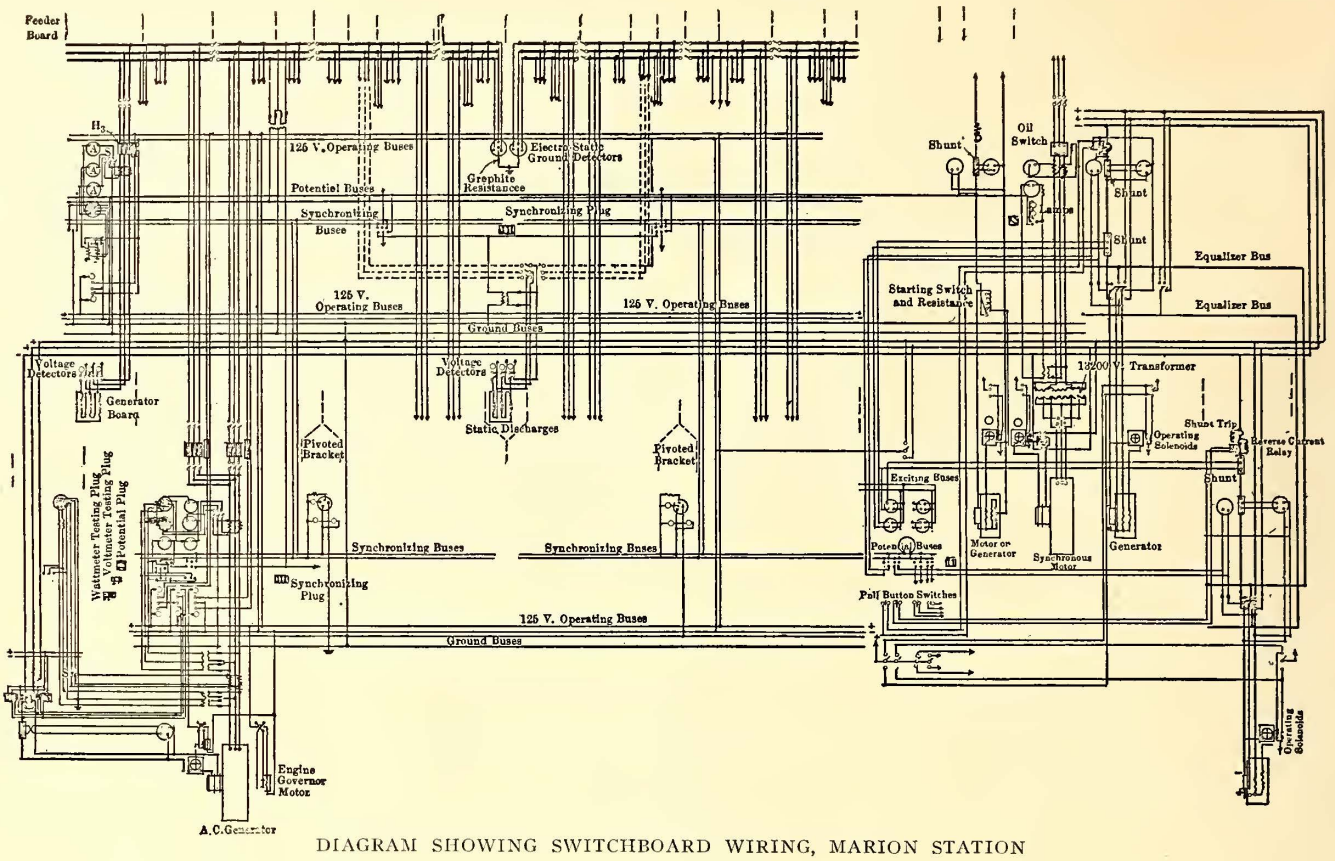
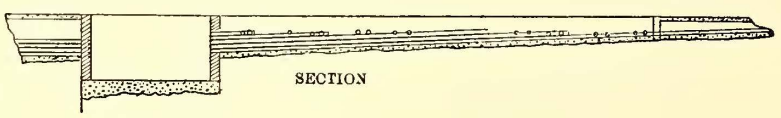
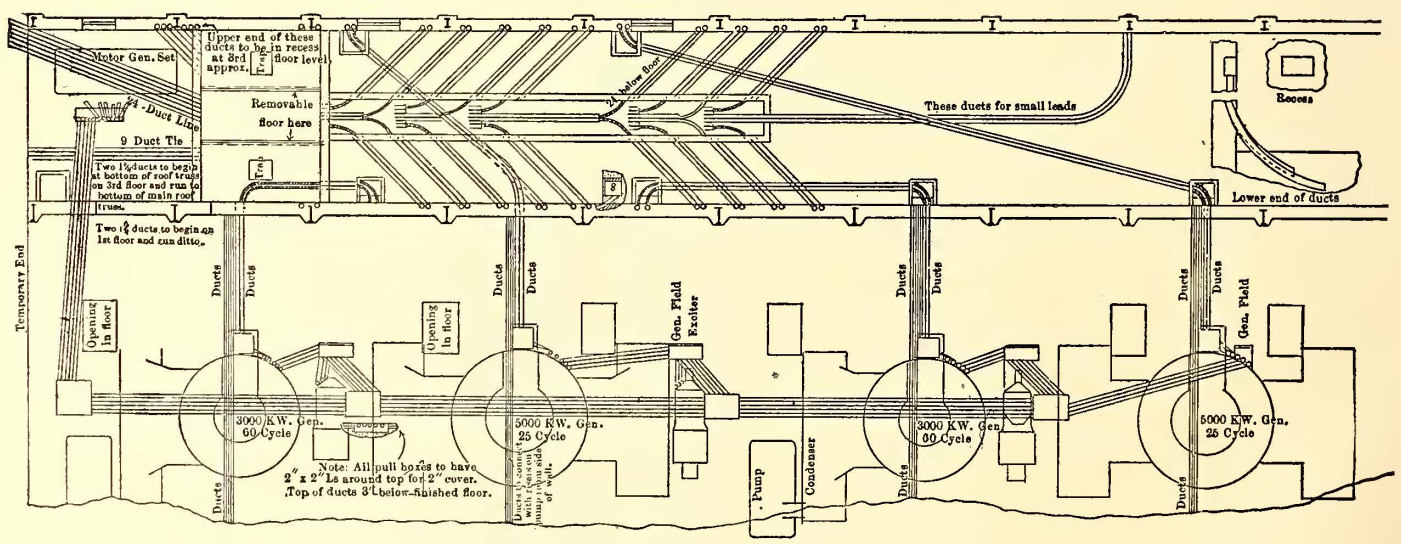


DIAGRAM SHOWING SWITCHBOARD WIRING, MARION STATION

The condenser outflow is led at an angle and away from the intakes into the river, below grade, by a 12-ft. x 12-ft. race-way, which has sides of sheet piling, bottom of concrete and is planked over on top.





FLOOR AND WALL DUCTS, MARION STATION

The foundations of the turbo-generators are worth special mention. They consist of a system of reinforced concrete arches permitting a free flow of the river immediately below the turbines, there being a series of 36-in. clay pipes connecting with the river. These pipes turn downward at the edge of a dock at the river front, and are hung in position by cross beams before the space beneath the dock is filled in. The mouth of these 36-in. inlets are 13 feet below low tide, affording an ample supply of water for condenser purposes. Provision has been made at this time for the supply of inlets for the ultimate capacity of the plant to 64,000 kw.

The condenser outflow is led at an angle and away from the intakes into the river, below grade, by a 12-ft. x 12-ft. race-

A unique feature of the station is the double condenser built by the Wheeler Condenser & Engineering Company for the 5000-kw turbines. Each condenser has 10,000 sq. ft. of surface, or 20,000 sq. ft. to each 5000-kw unit. The top row of

tubes in each condenser is used as a closed feed-water heater, the water flowing thence to the open Cochrane heaters, of which there are two of 6000-hp each. The 3000-kw turbine condenser has 12,000 sq. ft. of surface. Each turbo-unit has a duplex Edwards direct-driven suction valveless air pump, supplied by the Wheeler Company. This pump is 12 ins. x 30 ins. x 14 ins., and is used as the condenser and air pump.

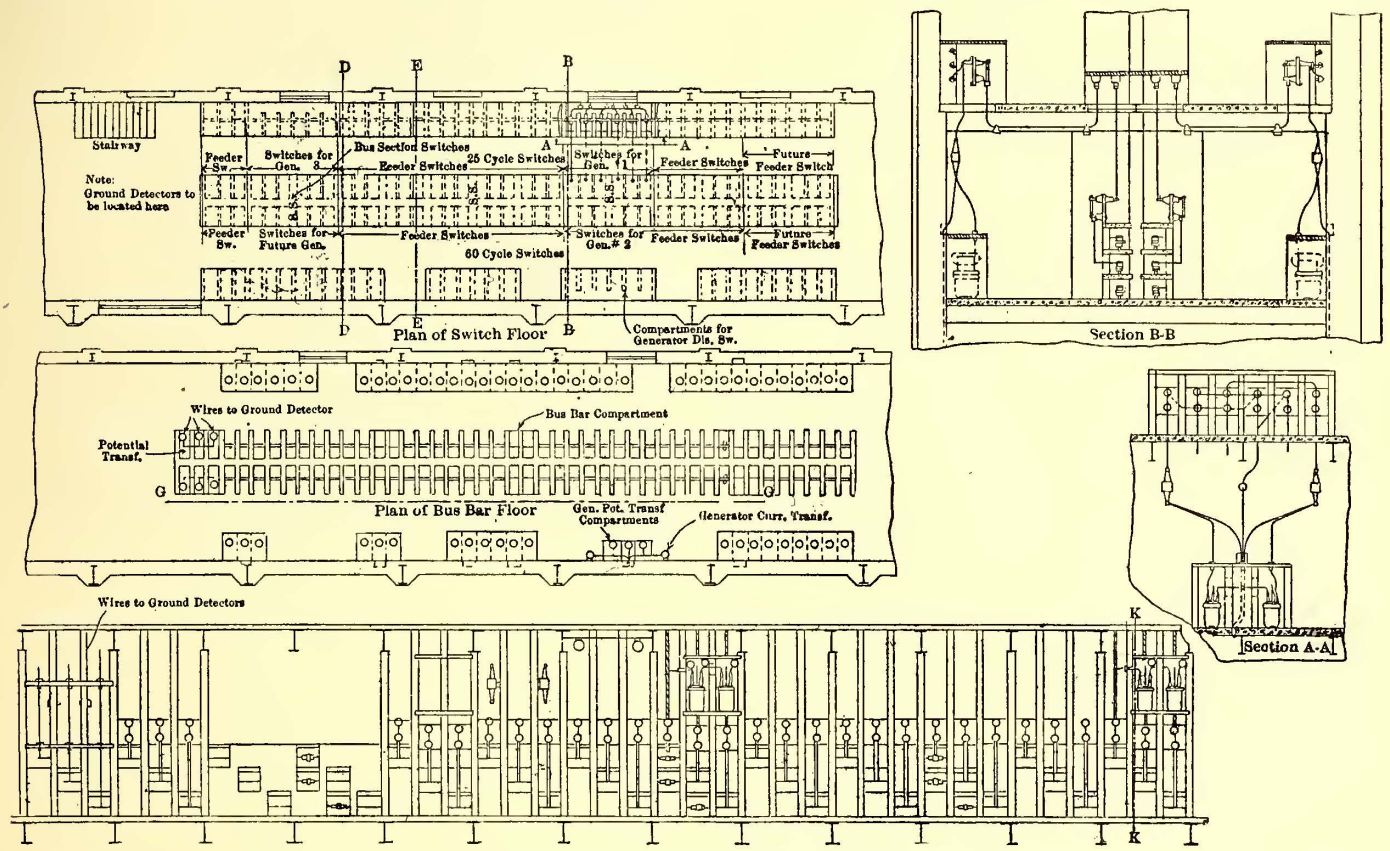
There are two 125-volt exciters, each of 75 kw., direct connected to small horizontal Curtis steam turbines. One of these generators is sufficient for the entire present equipment. These turbines are non-condensing and exhaust into the open heaters.

The exhaust from all the steam auxiliaries goes into a main leading into the open heaters, and by means of a divided box in this main between the two heaters, the inlet to each heater can be proportioned as desired.

A leader is taken from between the stages of the large turbines at about atmospheric pressure and run direct to the open heaters. This is to raise the temperature of the feed water up to 210 or 212 degs.

There are three vertical Warren boiler-feed pumps, each 14 ins. x 11 ins. x 12 ins. stroke, running 50 to 100 strokes per minute, capable of delivering 980 gals. per minute. Each has an 8-in suction and 7-in. discharge. The auxiliaries in this station are all steam driven and run non-condensing, utilizing the exhaust from them to the fullest extent for heating the feed water. The amount of such exhaust steam, however, in the turbine plant is not sufficient to raise the temperature more than 50 or 60 degs., so provision was made to bring this temperature up as stated.

In addition to the advantage of feeding hot water to the boilers at a constant temperature, there is considerable economy secured by this use of steam after it has done work from boiler pressure to atmospheric pressure in the turbine. Both the sensible heat and all of the latent heat is utilized in the heater while the only further work steam could do when used expansively in the turbine, is that due to difference of temperature from atmosphere to 28 ins. of vacuum. The amount of steam used for this purpose from the turbines will depend, of course, upon the proportions of station lead to steam obtained from the auxiliaries, this being controlled by a hand valve with a back-pressure valve in the line.



ARRANGEMENT OF SWITCHING APPARATUS, MARION STATION

The system of feed-water supply consists of the following parts: The Edwards air pump receives the water of condensation from the condenser and returns it to the open heater, which acts as a hot-well. The heaters are of sufficient capacity to store a 10-minutes' supply to the boilers. In the run between the air pump and the heater is a primary heater in the top rows of tubes of the surface condenser.

The water is forced through these condenser tubes, and by virtue of their contact with steam upon its return to the condenser, the water is heated to the full temperature of the vacuum; it is then led to the open heaters. The complete circuit of the system in feed water is from the boilers to the turbines as steam, from the turbines to the condenser, condenser to pump, pump through primary heater, primary heater to open heater, open heater to feed pump, and feed pump to boilers. The entrained air escapes from the discharge of the Edwards air pump through a 12-in. riser carried above the water line. Feed water is supplied from either the city mains or from spring water on the property.

There are fifteen Babcock & Wilcox 600-hp boilers, five boilers being in a half section supplying the smaller stack, and ten boilers in a section for the larger stack. Except the outer or half-section row, the boilers are back to back, the flues being of brick and below the boilers, sealed with cement. The flue dampers are iron plates swung on a vertical axis, and are at an angle when closed. McClave grates are used. There are no mechanical stokers, but provision has been made so that if desired they can be installed later.

Below each boiler is a flame plate, consisting of a slab of 6-in. reinforced concrete supported on each end on iron girders.

The steam piping is all overhead and is suspended from the structural steel framework, permitting free movement of expansion. So-called Van Stone joints, supplied by H. W. Kellogg, with vulcabeston gaskets are on all the 6-in. auxiliary mains and the 10-in. line steam feeder lines. All runs are

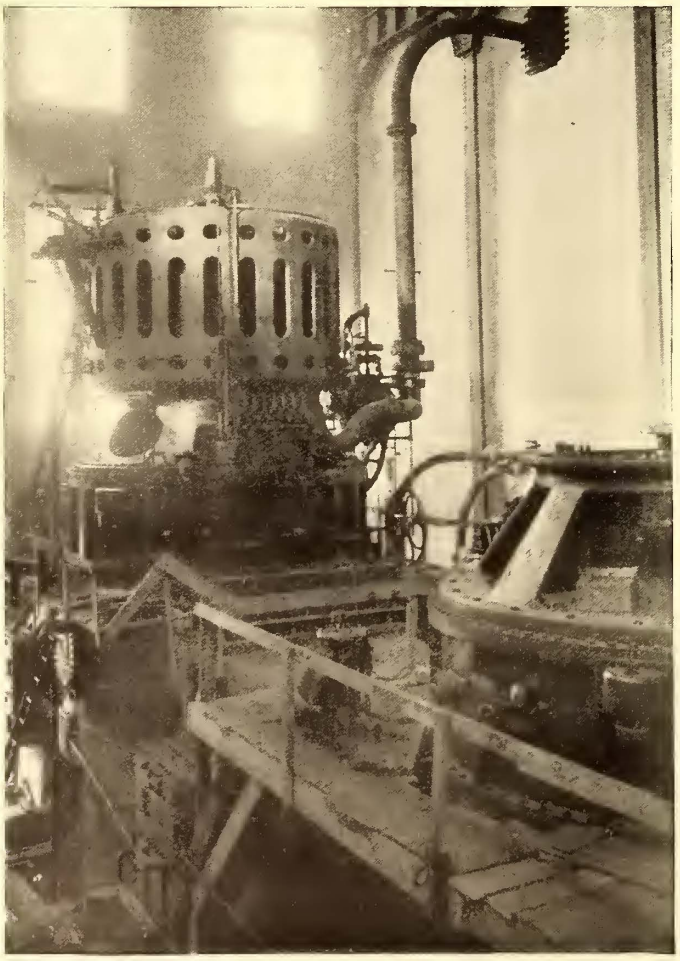
curved to guard against straining joints. Chapman valves are on all steam connections except valves below 4 ins., where Hancock globe valves are used. The blow-offs are connected to the feed-water lines as an emergency source of feed-water supply to the boilers. The pipe covering on the superheated lines is 3 ins. thick, of 85 per cent magnesia, laid on in 1½-in. thicknesses, plastered with a ¼-in. layer of asbestos compound and then covered with 8-oz. duck sewed on. The other steam piping is sectional covering. The relief valves on the 5000-kw exhaust is a 36-in., and on the 3000-kw turbine a 30-in. Blake valve.

The coal is handled by electrically-operated machinery from the supply pile to the storage pockets over the boiler floor space, and is then let down on the floor by local coal chutes controlled by the fireman. The ashes drop from the grates into steel hoppers lined with concrete to conduct the ashes to chutes, the openings of which are controlled at will. Ash cars on standard-gage tracks receive the ashes direct from the chutes and convey them away from the plant.

WIRING

The cables from the generator to the generator busses, the exciter wiring and the general current controlling wiring and apparatus is shown in the accompanying illustrations.

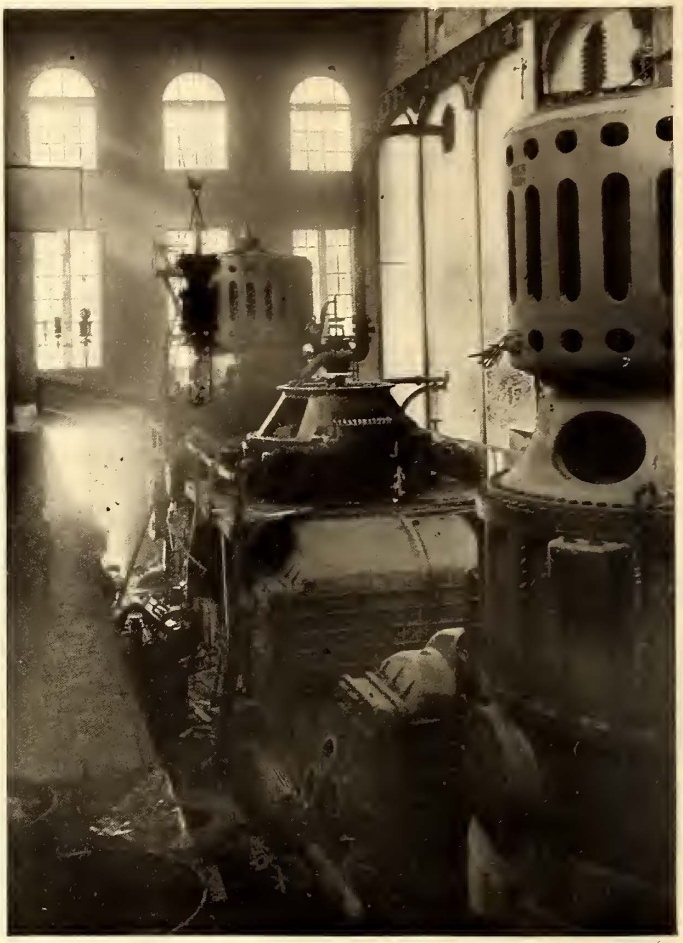
The three conductor cables from the generators are all lead in ducts imbedded in the station floor to the basement of the switch building, thence exposed along the wall to the respective sectional bus. The system of busses of flat copper bars are separated one from the other by brick chambers. From the



TWO TURBO UNITS IN COURSE OF ERECTION, MARION STATION

busses leads are taken to the respective circuit-breaking oil-pot switches, the triple circuit-making and breaking copper rods being mechanically operated and electrically controlled from the operating board.

The instrument panels and operating bench are placed at one end of the present top floor of the switchboard building and on a level with the gallery, which is on one side and end of



VIEW IN TURBINE ROOM, MARION STATION DURING CONSTRUCTION

the engine room and interconnects the turbines. The operator can overlook the generators and face his operating bench at the same time.

The generator supply to each bus is controlled by an oil circuit-breaking switch, also with remote control, and which has the auxiliary time limit and reverse-current relays in circuit for protecting the generators and system. From the bus-bars the current passes to the floor above by separate cables, each being in circuit with an oil switch and connecting to the feeder circuits. Each circuit from a generator has two mains, one of which can be connected to an adjacent sectional bus, which are, however, kept normally closed by clip switches.

The feeder circuits pass downward through ducts to the basement and fan into a series of pull boxes and thence to the cable wall and underground conduits, each being protected by General Electric lightning protectors, which also take care of any unusual rise in voltage.

Current and potential transformers supply the instrument on the panels near the operating board, so that only low voltage is in the vicinity of the operator. The current transformers also operate the automatic control of the circuit-breaking switches.

The cables are insulated with rubber coverings, except when they are a continuation into the building from underground. In these cases the cables are rubber core with paper insulation, protected with lead covering. The cables pass into cable bells on the second floor, each of the three leads being carefully brought away from each other and taped, and the bell filled with insulating compound.

All the current from the exciter sets is brought to the low-tension board on the operating floor and distributed and controlled from there.

A novel feature in the equipment of the switch and cable building is the 100-kw General Electric motor-generator set consisting of three machines. There is an a. c. synchronous motor of 600 volts, 25 cycles, supplied by static transformers stepping down from 13,200 volts. On the same shaft is a d. c. 125-volt and a d. c. 500-volt machine, both interchangeable as motors and generators by a method of switching.

The purpose of this special set is to obtain any possible desired current for testing work. It is possible to take trolley current and generate a. c. 600 volts or 13,200 volts for testing, or use 125 volts d. c. for exciter current or for lighting the station. Driving by the a. c., the 500 volts d. c. can be used for operating the coal handling or the crane motors. Or it is possible to drive the set with 125 volts d. c. from an exciter and use either 500 volts d. c. or 600 or 13,200 a. c. for testing.

The operation of this station will greatly relieve the heavy demand for energy on the other central stations of the corporation and provide a reserve in case of accident to any of the plants. In an early issue will be published additional details of the power generation and distribution on the Public Service System.

Special mention should be made of the courtesy received from Dudley Farrand, general manager; James T. Whittlessey, chief engineer, and Mr. Vassar, assistant engineer, for the facilities and information afforded in the preparation of this article.

ELECTRIC RAIL-WELDING IN CAMDEN

A considerable number of the visitors to the Philadelphia convention last October crossed the river to Camden to visit the system of the Public Service Corporation in that city, and also to inspect the electric welding of joints which was being carried on at that time. During the last few months the Lorain Steel Company has been completing a contract for the electric welding of 3087 rail-joints on the South Jersey division of the Public Service Corporation. About one-third of these joints were in the city of Camden proper, while approximately the other two-thirds were on the Haddonfield and Moorestown divisions of the company. In Camden a portion of the rail, as shown in Table II., is laid in asphalt, with Belgian block along the rail, a part in brick and a part in macadam. On the other two divisions all of the track was in macadam. On these two latter divisions a high-speed interurban service is run. The work has been carried on under the direction of P. Ney Wilson, supervisor of the company, and the result of the electric welding, according to the company, has shown a marked improvement both in the riding qualities of the track at the joints and also in ground return.

All of the joints welded were in a more or less battered condition, so that the joints had to be raised before being welded. This was done by raising the receiving rail so that the lowest point in this rail was level with the head of the abutting rail, after which the elevations were ground off with a corundum wheel. It has been found that the electric weld holds the rail absolutely firm and that the rolling of wheels across the joint since the work was finished has tended to make the joint smoother than it was immediately after the welding. It is true that by grinding off a portion of the head of the rail some of its wearing qualities are sacrificed. The experience at Camden, however, has been that this is necessary and that the battered end of the rail must be ground level before a good joint can be obtained.

Table I. shows a summary of the cost of electrically welding these joints, including contract price of $5.25 per joint. Table II. shows the cost per joint, type of paving, type of rail section and number of joints welded on each of the five streets on which the work was done. As will be seen from these tables, the cost per joint varies from $6.632 to $10.438, with an average of $7.635. This price, however, should be considered in connection with the maintenance charge of the joint with which this price is compared. Mr. Wilson, for example, estimates that the life of the welded rail on the Haddonfield Pike will be eight years, whereas during the last two years with angle plate joints this track has cost the company about $1 per joint each year for tightening bolts and shimming. This maintenance work has only temporarily relieved the situation, for each year the joint has been worse, and it was estimated that at the end of four years the rail would have been so bad at the joints that the track would have to be relaid. In other words, it is expected that in this particular case, by electrical welding, the life of the rail will be practically doubled at a less cost than would have been required simply for maintaining angle plate joints during the life of the rail.

TABLE I.—COST OF ELECTRICALLY WELDING 3087 JOINTS IN CAMDEN, N. J.

Cost of labor	$7,031.24	
Cost of material	581.09	
	$7,612.33	
Credit from sale of old fish-plates and bonds.	2,816.59	
		$4,795.74
Cost of welding 3087 joints, at $5.25 each		16,206.75
Cost of replacing asphalt, 899.6 yds., at $2.53; 117 yds., at $2.51		2,569.65
Total cost of operation		$23,572.14
First cost per joint, labor		2.277
First cost per joint, material		.188
First cost per joint, labor and material		2.465
Cost per joint, labor and material, after credit is deducted		1.553
Final cost per joint, all labor, material, welding and asphalt charges		7.635
Cost per mile, under similar conditions, 30-ft. lengths		2,687.52
Cost per mile, under similar conditions, 60-ft. lengths		1 343 76

TABLE II.—COST PER JOINT, PAVING AND RAIL SECTIONS ON THE DIFFERENT STREETS

Haddonfield Pike, 7-in. girder (P. S. Co., section No. 238 and Cambria No. 824; rubble stone on sand, 989 joints	$6.684
Moorestown Pike, 9-in. girder and 7-in. girder (P. S. Co. sections 238 and 200); rubble stone on sand, 1128 joins	6,704
Broadway, 7-in. girder (P. S. Co. section No. 238), asphalt between rails and part of shoulder, Belgium block along rail, on 6-in. concrete, 715 joints; Kaighn Avenue, 7-in. girder (P. S. Co. section No. 238), bricks between rails and shoulder, on 6-in. concrete, 64 joints; total, Broadway and Kaighn Avenue, 779 joints	10,438
State Street and River Road, 7-in. girder (Cambria section No. 834); rubble stone on sand, 191 joints	6,632
Total .....3087 joints,	7,635

Santa Ana, Cal., did elaborate honor to Henry E. Huntington on Nov. 22, the occasion being a formal celebration of the opening of the magnificent new line of the Pacific Electric Railway Company between Los Angeles and that city. Flags, banners and bunting were everywhere in evidence. Many stores were decorated with the national colors, and on thoroughfares everywhere flags were strung from house to house. The parade presented the finest pageant ever witnessed in Orange County. The opening of a strictly modern standard-gage electric railway over 30 miles long with metropolitan service marks the beginning of a new era in the progress of one of the richest and most promising sections of Southern California, which has proved to be rich in splendid possibilities for freight and passenger traffic. There were many floats in the parade, harmonious in the plan of representing the leading industries of Orange County. Peanuts, honey, small vegetables, potatoes, celery, sugar beets, dried fruits, walnuts, apples, peaches, raisins, alfalfa, oranges, red chili peppers, poultry, peat fuel and dairy products comprise a list of the leading industrial activities of the county. Old soldiers in the parade cheered Mr. Huntington, and an elaborate banquet was tendered him in the evening. Following the parade in the forenoon, William E. Dunn, of the law department of the Pacific Electric Railway Company, responded happily to an address of welcome for the city. It is estimated that the railway company handled between 15,000 and 20,000 people for the celebration of the most eventful day in the history of Santa Ana.

EXPERT REPORT ON SAN FRANCISCO'S STREET TRAFFIC PROBLEMS

The Merchants' Association of San Francisco some months ago engaged William Barclay Parsons, of New York City, the eminent authority on traction facilities for cities, to investigate the traffic conditions in San Francisco and recommend a general plan for the development and improvement of the city's transportation and street traffic arrangements. Mr. Parsons, in his report, outlined a broad scheme for substituting the overhead trolley for cable on all of the street railway lines, and recommends tunneling under the peaks of the hills where necessary to avoid grades in excess of 14 per cent. He does not believe the city as yet needs a subway. With the report is included an ingenious scheme for terracing the roadways on certain streets, so as to make them accessible to horse-drawn vehicles. Mr. Parsons prefaces his report with the statement that his opinion had been asked regarding four "main points" or questions, which were framed in the following language:

"First—As to the desirability of constructing a subway in this city for taking care of the future street travel, and the time when such subway should wisely be commenced—reviewing the situation with a view to the future growth of the city, which, it is anticipated, will be very rapid.

"Second—Should the subway be built upon Market Street only, the place where the congestion now most shows itself, or should it be built with branches to cover a more extended territory?

"Third—What, in your opinion, is the proper system to be used in rebuilding the Sutter Street line, if done to-day, without regard to future subways or a single complete system?

"Fourth—If the city desires to undertake the operation of a line of its own on Geary Street, what system would you recommend? The chief desire of the Merchants' Association is to know what is the most perfect and comprehensive system which can be adopted for the greatest convenience of the traveling public of the entire city, including, if you choose, a recommendation for all lines in the city.

"The Merchants' Association has heretofore stood firmly opposed to overhead wires in business districts, and in renewing any of the present branches or existing lines believes none but the best possible system should be adopted."

The report then continues:

San Francisco is a city on the end of a peninsula which has a width, from the Bay of San Francisco on the east to the Pacific Ocean on the west, of about 7 miles. The present limits of the city, which are formed by the water front on the east, north and west, and by the county line drawn straight from east to west on the south, give it a rectangular form, with an area of about 47 sq. miles.

Topographically, the surface of San Francisco is much broken. One main ridge extends north and south substantially in the center of the peninsular, the peaks of which in many places have an altitude of 800 ft.. At the northeastern corner of the city there is a sharply marked rise known as Nob Hill, whose elevation exceeds 300 ft. To the east the surface falls away rapidly to about Dupont Street, while on the west the ground first descends and then rises on the eastern flank of the main ridge.

The eastern portion of the city, especially immediately south of Nob Hill, is practically level, and the extreme western side lies on a comparatively uniform slope on the western flank of the main ridge.

In the original plan of the city it was unfortunate that the striking features of the local topography were disregarded, and that streets were located without reference to gradients. Market Street, the largest thoroughfare, however, beginning at the water front and running southwesterly, skirts the southern extremity of Nob Hill, and is nearly level for a distance of about 2½ miles, when it begins to rise. It is now, and of necessity

PRESENT CONGESTION OF CABLE CARS AT FOOT OF MARKET STREET, SAN FRANCISCO

must always continue to be, the main artery of travel in San Francisco. North of Market the streets have been laid out on a rectangular plan, running nearly north and south and east and west, and making angles of about 45 degs. with Market Street. To the southeast of Market the streets are also rectangular, but parallel with and at right angles to it.

WHERE GROWTH CAN BE PREDICTED

The topography and the layout of the streets fix the commercial and residential portions of the city. Commerce cannot, and consequently will not, follow streets which have gradients so steep as to be impossible or inconvenient for ordinary dray and wagon delivery. San Francisco may therefore expect to see the retail district follow the general line of Market Street and the streets immediately adjacent thereto on the north so far as the gradients are of a moderate inclination. The area lying to the southeast of Market Street and extending directly to the water front will probably be the wholesale territory, while the district north of Market Street and to the east of Nob Hill will continue to be, as it is at present, the financial center.

Portions of Nob Hill are now the location of some of the finest private dwellings in San Francisco, and on account of the view which the eminence affords, this site forms a most admirable one for such use and for still further development. Unfortunately, other parts of Nob Hill are given over to the Chinese quarter and buildings of an undesirable character, as the excessive street gradients make it impossible to convert such territory into dwelling areas of the best type. The present residential district of Nob Hill is small, and while it is capable of being increased by removing the existing objectionable gradients in a way that I shall point out later, it is only large enough to provide sites for a portion of the better class of residences.

MAP SHOWING COMPARATIVE DENSITIES OF POPULATION IN SAN FRANCISCO

THE NEED OF TRANSPORTATION

At present the territory which lies to the west of Nob Hill, to the north of Golden Gate Park, and to the south of the Presidio Reservation, is being covered by dwellings of high quality. Already a great part of this area is solidly built over, leaving the only territory open to a great development for residential districts, within the limits of the municipality, that toward the south and southwest. If such local extension is hindered by lack of interurban communication, the suburbs across the bay will receive an increased stimulus and will serve as dormitories for the future population, who will be carrying on their daily vocations within the city proper.

The population of the city, as officially counted by the Federal census of 1900, is 342,782. The local school census taken at previous and following five-year periods has served, when compared with the Federal census, to closely approximate the population as it stood in 1895, five years before the Federal census and five years after, in the present year. At these three periods it can be stated that the population has been and is as follows:

1895	332,000
1900	342,782
1905	432,000

The great development that has taken place during the past five years, which is very evident to one who visits the city at intervals, is shown by the above table.

DENSITY A LARGE FACTOR

In the matter of local transit, it is not so much a question of serving a total population as the serving of relative densities of population. From tables given in the report it is shown that the density varies between the maximum in district 43, with 309 persons residing in each 100,000 sq. ft., to the minimum in the greater part of district 36, where there are but 3 persons per 100,000 sq. ft.

In order that the figures may be presented visually so as to give a better means of comparing totals than by a statement of figures, a map has been prepared and attached hereto, indicating by different degrees of shading the densities of population as they exist in the present year. The map shows the number of people residing per 100,000 sq. ft. of area (2.3 acres).

STREET RAILWAYS OF SAN FRANCISCO

The local transit systems of San Francisco are owned by four companies, whose names, together with the total miles of route of single track, are as follows:

Name	Miles of route	Miles of track
United Railroads	138.55	260.33
California Street Railway	5.37	10.74
Presidio & Ferries Railway	4.63	9.01
Gear Street, Park & Ocean Railway	4.13	8.26
	152.68	288.34

It is understood that the franchise of the last-named company has expired, and that the company is continuing in operation by temporary sufferance on the part of the municipal authorities; but it is not necessary for me to enter into a discussion of this question. This report will therefore continue to regard the Geary Street, Park & Ocean Railway Company as an actual organization.

The above track mileage is operated by four different methods, electricity, cable, horse and steam, as follows:

Name	Electric	Cable	Horse	Steam	Total
United Railroads	204.72	52.19	3.42	....	260.33
California Street R'y	.....	10.74	....	....	10.74
Presidio & Ferries R'y	.....	6.00	1.76	1.25	9.01
Geary Street, Park & Ocean Railway	.....	8.26	....	....	8.26
	204.72	77.19	5.18	1.25	288.34

The traffic on these lines is increasing even at a higher ratio than the growth of population, as is always the case in a city whose commercial activity increases with the population. The fiscal years of the companies do not exactly agree, and it is therefore impossible to give the exact number of passengers carried, nor is it necessary to do so, because for such an investigation as this the approximate totals suffice. It may be said, therefore, that all companies are now carrying paying passengers, exclusive of transfers, at the following rate per annum:

United Railroads	137,500,000
California Street Railway	8,650,000
Presidio & Ferries Railway	3,850,000
Geary Street, Park & Ocean Railway	3,970,000
	153,970,000

In addition to the above there are more than 40,000,000 passengers per annum who find it impossible to continue the journey by single car, and who receive transfers from the various lines as follows:

United Railroads	38,500,000
California Street Railway	1,600,000
Presidio & Ferries Railway	1,600,000

HOW THE TIDES OF TRAVEL MOVE

As an analysis has been made of the distribution of the population of San Francisco, so it will be interesting to make an investigation of the traffic on the surface lines. Taking Market Street as the backbone of the city, of the total paying passengers carried on the street railroads, amounting to 154,000,000 per annum, 92,400,000 passengers are carried on the lines running to points north of Market Street, including such lines as McAllister and Haight Streets, which run on Market Street as well as on streets north of it. Similarly, the lines that lie south of Market Street, including those of Castro and Valencia, carry 61,600,000 passengers.

In the former system of railroads there are 78.76 miles of route and in the latter 81.31 miles, including a repetition of the mileage on Market Street according as it is used jointly; so that the number of passengers carried per mile amounts to 1,174,700 in the former case and 757,600 in the latter. The traffic, therefore, on the northerly system, as compared with the traffic on what we may call the southerly system, is in volume in the ratio of 3 to 2. From these figures it will be seen that while one part of the city has a volume of traffic somewhat greater than the other, the difference is in accordance with the variations in population, and indicates no decided trend in either direction.

The details agree with this general conclusion. Thus, the McAllister Street line, the one of the greatest travel in San Francisco, has a density of about 2,000,000 passengers per route-mile, or about twice the average for all the lines in the city. This difference between the maximum and the average is unusually small and indicates a general distribution of travel. While such distribution is a public convenience as avoiding excessive congestion, it shows the lack of any great traffic route, the volume of travel on which calls for, or would make profitable, an extraordinary outlay of capital.

The Market Street system is made up of five different lines, all of which originate at the ferry, run along Market Street and diverge from it at McAllister, Hayes, Haight, Valencia and Castro Streets. In addition to the through lines there are five that come to a dead-end terminus at Market Street. Omitting any interchange of passengers between the California and Geary Street companies with the United Railroads on Market Street, 50,000 passengers are compelled to transfer daily between the Market Street cars and those of the five tributary lines. This is a great inconvenience to the public.

As to passengers coming to and going from San Francisco, the Southern Pacific Railway Company delivers at its station on Third Street, and the same company, together with the Santa Fe Railroad and the Key Route, deliver at the ferry houses at the foot of Market Street a steadily and rapidly increasing number of suburban passengers. Such travel at the present time is substantially:

Southern Pacific Railway	1,600,000
Southern Pacific Ferry	20,700,000
Santa Fe Ferry	350,000
Key Route Ferry	5,300,000
	27,950,000

Of this total, about 25,500,000, or, say, 90 per cent, are suburban passengers, carried to and from San Francisco at the rate of about 70,000 daily.

The existing railway system of San Francisco has two striking features: First, diversity of methods of operation, in which respect it is unique among the cities of the United States; and second, that it still retains the use of horses, as does no other city in the United States except New York. San Francisco also continues to use the cable, while in the other cities of the country it has long since been discarded, or efforts are being made to do so.

ESSENTIAL REQUIREMENTS OF GOOD STREET CAR SERVICE

The maximum efficiency is rendered by a transportation system when the methods of operation are reduced to the simplest form with absolute uniformity.

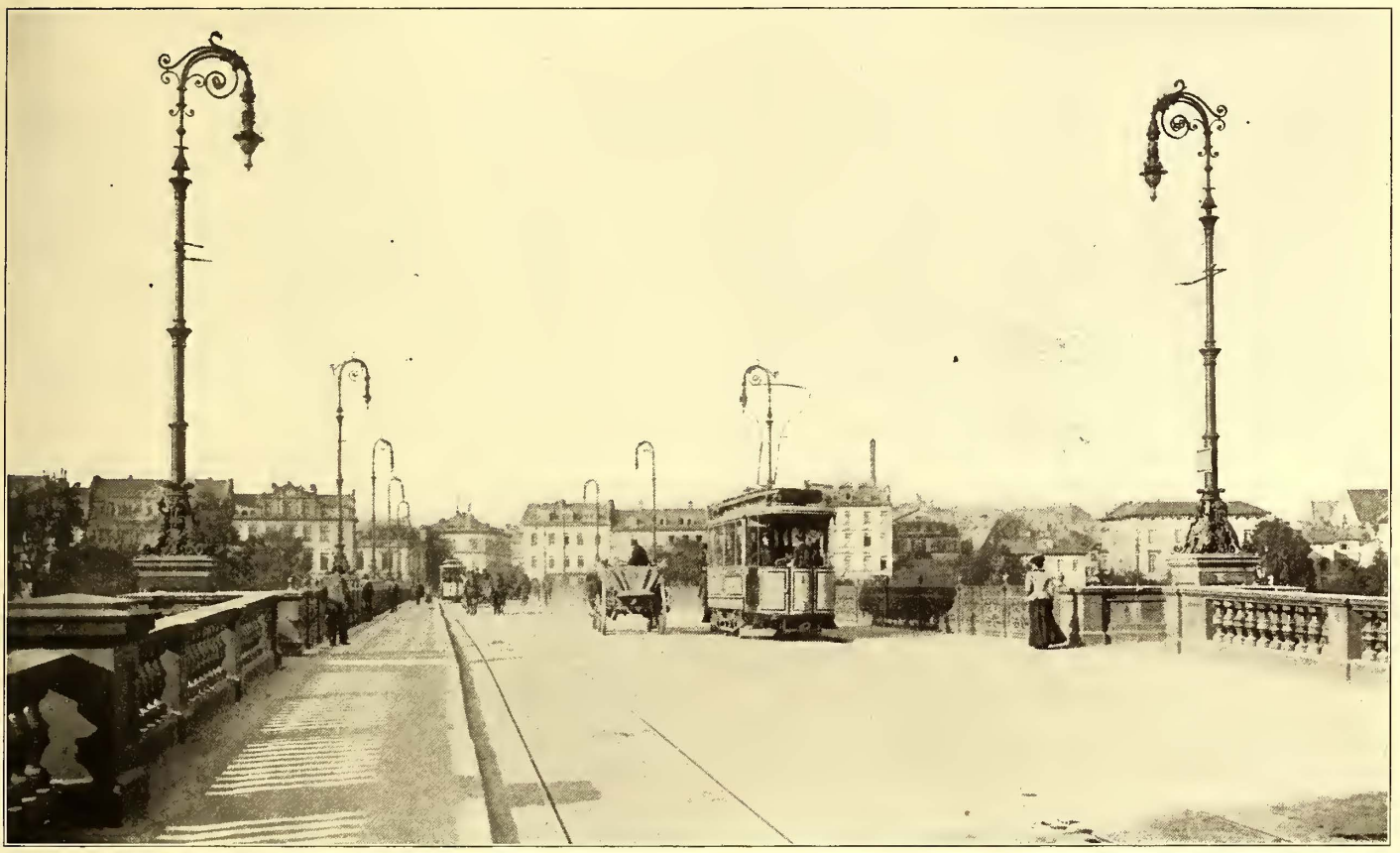
It is obvious that the greatest convenience to the public will have been realized when a passenger can take a car at any point and go to his destination on the same car without the annoyance and delay of transferring. Such an ideal arrangement is not capable of entire realization, but any break in the operating arrangement places an additional difficulty upon its accomplishment.

In the present state of the art of transportation, electricity is the most satisfactory means of applying power; it is clean, elastic, capable of producing high speed, easily controlled and economical. Steam as a power should not be permitted within a city's limits; horses are thoroughly inefficient; while the cable lacks elasticity and is defective in speed. The unfortunate street gradients of San Francisco have apparently demanded the continued use of the cable, although it has been abandoned in other cities. Horses and steam can be easily removed; and they should be removed, promptly. It will be seen, as will be shown later, that the cables are not as necessary as they have appeared to be, and that they, too, can be made to give way to a superior form of operation. I shall therefore recommend to your association the abolition of all forms of motive power except electricity as the most radical and fundamentally far-reaching improvement that can be made to your local system.

Believing that the method of operation for the sake of the traveling public should be of one type, so as to give it the highest elasticity, I shall couple the above recommendation with

the further one, that one system of electrical operation be adopted and made uniform throughout the city. The question, therefore, at once arises, how should the electricity be applied, whether by storage battery, by conductor bars laid in conduits, or by overhead trolley? Other methods have been tried, but nowhere as yet have experiments been on a sufficiently large scale to warrant generalization. The answer to this question will dispose of the third and fourth heads in the letter of instructions as given in full at the beginning of this report.

The above three methods of application in electricity have all been tried. The storage battery has been given an extended experimentation, but as at present constructed, or with even such means as now seem possible of application, there is nothing to justify its use; and the possibility of so doing may therefore be disregarded, at least until such time as some radically new form of battery is devised.



ORNAMENTAL SIDE TROLLEY POLES WITH ARC LIGHTS IN USE IN FRANKFORT

HISTORY OF THE UNDERGROUND CONDUIT

Operation by conduit has been tried in three cities: first, in Boston, where it was a complete failure, and where the conduits were taken up and replaced by overhead trolley; second, in Washington; and third, in New York. The adoption of the conduit system in the second-named place was the result of an accident. The Washington railroads were formerly all operated by cable, the sub-structure for which, including the tracks, had been laid in the most approved manner, all properly subdrained. The main power house of the operating company was destroyed a few years since by fire. As the company did not desire to reinvest its capital in a means of operation that was confessedly ineffective and expensive, and as the Federal authorities would not permit the use of overhead wires, and further, as the conduits had been so well built that it was only necessary to remove the cable and place within the conduits the conductor bars and necessary electrical connections, it was decided to equip the lines as a whole for conduit operation. The very important feature is to be borne in mind, in this connection, however, that the work was done, not on individual lines, but on the entire system.

In the case of New York, the proposition to supplant horse operation by mechanical means was undertaken at a time when all the main streets and many of the less important ones were congested by a great mass of telegraph and telephone wires, which, together with their poles, the municipal authorities and the public generally desired removed. The position was then taken by the authorities before any work was done, that on no account would any more overhead wires be permitted. The company therefore introduced the cable on the important thoroughfares and retained the use of horses on the others until the method of conduit operation had been perfected.

This prohibition of overhead trolley wires covers only that portion of the city of New York now known as the borough of Manhattan. In the other portions of the city, which form the greater part of the total area, and which include at present about one-half of the population, no prohibition of overhead trolley wires has even been proposed, and all the railroads in such districts are operated by means of them. The railroad systems of the city of New York are divided as follows among the several means of operation:

	Miles of Track
Overhead trolley	870.11
Conduit trolley	212.49
Horse	99.74

The new work on conduits is practically limited to the conversion of horse lines in Manhattan, of which only 5.4 miles are in hand at present, while of overhead trolley 15 miles are actually in progress, with 35 miles projected.

In connection with New York, it is exceedingly important to point out, that while there is a large amount of trackage operated by conduit trolley, the spirit of uniformity has been strictly maintained, and this system is confined solely to Manhattan Island. There is no effort on the part of the company to introduce the use of overhead wires in the district now covered by the conduit lines; and the horse lines which are confined to that same territory are gradually being reconstructed to conduit operation, except on those streets located near the water

front, where high tides would be apt to flood the conduits and thus prevent electrical operation. In like manner, in the districts where the overhead trolley is the sole method of operation, no effort is made to make a change. Although the use of the overhead wire is generally prohibited on Manhattan

STREET IN DARMSTADT, SHOWING METHOD OF ATTACHING TROLLEY WIRES TO BUILDINGS

Island, this prohibition is elastic and does not extend to prevent the overhead trolley cars from the borough of the Bronx crossing the Harlem River and going to their points of destination in the upper part of Manhattan Island, nor to prevent the trolley cars of Brooklyn from crossing the bridges over the East River.

OBJECTIONS TO THE CONDUIT

With the exception of Washington and New York, no other city makes any use of conduit operation, and for two reasons: First, its adoption as part of a going system of railroads means the introduction of a new factor in operation and a breaking of uniformity; second, the operation of the conduit is known to be both expensive and as involving the possibility of annoyance and delay not present with the overhead trolley. The conduit slot is easily blocked by extraneous substances or flooded by water. Pieces of hoop iron may fall through the slot and by making short circuits cause not only serious delays, but often considerable physical damage. In the event of such accidents, the delay in making repairs is more serious than with the overhead wire. One-third of the delays on the conduit system of the surface street railroads of New York are due to accidents to the conduits. It would seem that it is only practicable to introduce the conduit economically when it can be done as in Washington—that is, after the result of an accident and under the extraordinary condition that nearly all of the underground work had been about completed; or second, as it was done in a portion of New York, where no other form of electrical operation had been introduced.

In respect to conduit and overhead systems, European practice is similar in principle to that described above. Although some electrical conduits are to be found in a few of the larger capitals, the amount of such work is comparatively insignificant, even in London, Paris and Berlin; while cities like Glasgow, Liverpool, Manchester and Hamburg have completely unified their systems with the overhead trolley. In all such cases the cities are larger than San Francisco, with narrower streets and with far greater congestion of traffic. The compelling reason is that better operation is secured and better results obtained for the same capital expenditure. Overhead trolley construction is the generally recognized standard. Experiments along various lines are in progress to develop a method of supplying power that will retain the advantages of efficient operation without the use of overhead wires, and it is possible that some such method may be successfully devised; but it will be many years before any system of this kind will be considered an approved success.

THE USE OF THE OVERHEAD TROLLEY

If the street railroad system of San Francisco did not exist, or if the Geary Street and Sutter Street lines were the only ones constructed, it is not even then certain that I should recommend that they be reconstructed for conduit operation. It would be better to take the amount of capital that the additional cost of conduit construction would represent and apply it either to the building of additional lines or to the improvement of the existing lines in the way of new equipment; because with a growing city it is often of great advantage to its development to have the transportation companies adopt a vigorous and aggressive policy in the way of extensions into new and sparsely built districts. Such a policy may readily be expected from corporations using the overhead trolley system.

SPAN WIRES ATTACHED TO BUILDINGS IN COLOGNE NEAR THE CATHEDRAL

There are many lines in all of our large cities which have built up their tributary districts to a high degree of density by pushing new trolley lines into virgin territory, and thus in a way testing the district. This is a good policy and one that is quite practicable with the overhead trolley construction; but, with the excessively expensive conduit system, it can never be justi-

fied, as the roads would go into bankruptcy before the country had time enough to grow up to the facilities.

The Geary Street and Sutter Street lines form but a small portion of the total mileage, and as it is impracticable from both the legal and financial standpoint to reconstruct the whole system of San Francisco railroads for conduit operation, it would seem to be a mistake to build conduits on the two lines in question and so introduce another discordant element and place another bar in the way of entire operating unification.

Some two years ago the British Government appointed a special Royal Commission to investigate the matter of local transportation in London. This commission appointed a board of three engineers (in which number I had the honor to be included), which reported to the commission, by whom it was sustained, strongly urging, for what is known as the metropolitan area of London, the necessity for a complete unification of the local lines and the extension of the tramway system by overhead trolley. Although the conduit method of operation was recommended for a very limited section in the central portion of the city for reasons peculiar to London, and in a district where no tramways exist at present, it was urged that such construction be rigidly restricted to this central area, and that all lines outside of that section be operated with the overhead wire, on the ground that such operation was more successful, and that the additional capital would be better spent in new lines.

It is this latter advice, which was considered applicable to London with its population of nearly 7,000,000, its enormous congestion of street traffic, its narrow streets and its great wealth, that I now beg leave to repeat for your own city.

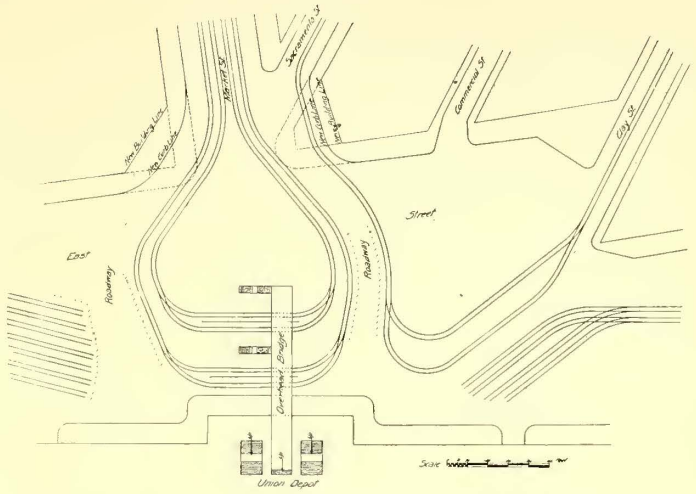
RELIEVING CONGESTION ON MARKET STREET

The number of passengers entering San Francisco from the ferries, a number which is steadily increasing, indicates the desirability of having as many lines as possible reach this point of passenger origin so as to reduce to the minimum the necessity of transferring from one line to another. The existing facilities cannot be improved as long as the tributary lines are

ORNAMENTAL CENTER-POLE CONSTRUCTION IN COLOGNE

operated electrically, while those running on Market Street are cable. To properly improve the situation, the Market Street lines now operated by cable should be reconstructed into electric railroads, and the tributary railroads, such as California, Sutter, Geary, O'Farrell and Eddy, should run all or some of their cars along Market Street to the ferry houses.

At present the Market Street line can carry no more cars, not that the limit of carrying capacity of the tracks has been reached, but on account of the terminal arrangement at the ferry. The present cable cars at the ferry have to be placed one by one on a turn-table and reversed in direction. If the cable were discarded, the turn-table could be removed, and in its place could be substituted loops around which the electric cars could be run. This is the method employed for turning the trolley cars at the Manhattan end of the Brooklyn Bridge, where 292 cars per hour are handled, with a total annual passenger travel of 110,000,000, which is about four times that of



SUGGESTION FOR TERMINAL LOOPS AT MARKET STREET FERRY

the total travel of the San Francisco ferries, only a portion of which, it must be remembered, takes the surface cars.

A plan is given which can be taken as a suggestion, in principle, of the ferry terminus. There are four different systems terminating at this point. The Mission Street and the other lines from the south have now a series of stub ends, which for the moment give reasonable results. The same is true of the Union and Broadway lines from the north. The Sacramento and Clay Street lines are united by means of a turn-table. If these lines were electrified a loop should take the place of the table.

It is with the Market Street lines that there is the most trouble. The four tracks, on reaching East Street, should be divided so as to give two loops for each track on the Market Street line. These four loops would give accommodations for cars to stand and load in front of the ferry house and permit their movement without obstruction or delay, and without blocking Market Street. To avoid danger to persons walking across these loops and the congestion and delays incident to crowds standing upon the tracks, a broad bridge could be constructed from the upper level of the ferry house, with steps descending to the inter-track spaces.

The car interval on the two-track line of Market Street is at present thirty seconds. This interval is fixed by the capacity of the ferry turn-table. Broadway, in New York, a street narrower between buildings than Market Street is between curbs, and with a vehicular traffic much greater, now carries cars at a seventeen-second interval, while the cars upon the Brooklyn Bridge run at twelve seconds.

By putting in electricity, which permits higher speed than a cable, and what is of more importance, permits cars to make short spurts, and free themselves from congestion, a closer interval can be maintained on Market Street than can be maintained on Broadway, owing to a smaller volume of other traffic and a wider street. The introduction of the trolley on Market Street, therefore, would about double the carrying capacity of the street. The existing congestion on Market Street occurs between California Street and the ferry, where, during the busy hours from 5 to 8 cars are blocked, from which the passengers usually alight some distance from the ferry and walk to save time. With the proposed loops the cars would run direct to the ferry plaza, and thus free the

street, not block each other, and save many passengers an unnecessary walk.

THE PROPER TREATMENT OF TROLLEY POLES

In reconstructing the Market Street line, I am keenly alive to, and sympathize with, the objection of the city authorities to the erection of poles in streets like Market Street, where they do not now exist, and even in streets where they are already in place. In suggesting the reconstruction of the Market Street line, I do not recommend a reproduction of the present overhead construction with its multiplicity of poles and network of feed-wires. The construction that exists, while strong and substantial, and similar to the overhead usually found in American cities, is thoroughly unsightly, and occupies too much space. In the cities of Europe, where there is but little conduit construction, the authorities permit the use of the overhead trolley for the reasons that have been given above, great care being taken, however, to see that such overhead construction is made as attractive as possible. The poles are designed according to artistic standards, and arrangements are made to combine lights with the overhead work so that one pole serves for both purposes. As illustrating European practice, there are here submitted photographs of streets upon the Continent, showing the construction of overhead work in a manner somewhat similar to that recommended in this report.

Especial attention is called to the picture of a street in Cologne, where the suspension wire spanning a narrow street is attached to the buildings, with the beautiful Cologne Cathedral, than which there is no more beautiful structure in Europe, showing directly in the background. The same construction is shown in the picture of Darmstadt, where the trolley wires swing around the picturesque round tower, and yet do not at all mar the architectural effect. The other two pictures indicate the practical application of the suggested combination of trolley and light poles. The other picture of Cologne shows the center-pole construction, and indicates very clearly the few wires that are requisite, and their slight obstruction to the sky line. In a similar manner, the picture of Frankfort indicates the side poles with a suspension wire, and illustrates strongly the minimum obstruction caused by overhead wires. In all these cases it is evident that all feed, telephone and telegraph wires have been strictly forbidden, the presumption being that they are carried in sub-surface ducts, just as is recommended elsewhere in this report.

It is impossible to remove all poles from our city streets—we must have some for lighting—but there is no reason why San Francisco should not do as is done in Europe, and make the same pole serve for trolley wire, lights, street signs, and fire alarms and mail boxes. The trolley poles in San Francisco are now set at intervals of about 100 ft., with poles for lights and telegraph wires in addition. This is much closer than is necessary; if properly designed so as to give sufficient strength, they can be set at intervals of at least 200 ft., and probably 300 ft. Experiments in placing poles at such distances are now being made on some of the lines in New York, and that under climatic conditions of sleet and ice, which tend to break down the wires, that will not be present with you. If poles should be set at the longer interval, the copper wire should be suspended from a steel supporting wire by insulating attachments at intervals of 10 ft. to 15 ft., the result being not only better insulation, thus preventing the danger from leaking currents, but in case of broken wires the ends will be too short to reach the ground, and so will be prevented from becoming dangerous.

An interval of 300 ft., however, is probably too long for street lighting, and it is therefore recommended that the poles be placed at such intervals as the city authorities deem proper for lights.

On Market Street the poles could be placed in the center of the street between the tracks, which are now far enough apart to permit the running of the largest car used in San Francisco, with a row of poles between. These should be made with cross-arms carrying the two wires with a light between, and a suggestion for such a pole somewhat similar to European designs, but better adapted to American manufacture, is herewith given. This arrangement of lamps down the center will give an even distribution if light over the whole street surface. The existing light poles on the sidewalks can be removed, and the roadway will be no more obstructed than it is at present.

In narrow streets, where center poles are not possible, the overhead wires can be carried by a restricted system of poles with ordinary span wires from curb to curb, the poles being used for the support of both lamps and span wires and placed at the intervals considered proper for street lights. Under this arrangement the only additional obstruction will be the span and longitudinal trolley wires, which are almost insignificant. The span wires can be attached also in some cases directly to the houses, as is done in Europe, and in some streets in San Francisco. In order to prevent any possibility of vibration being transmitted to the houses, it is customary in Europe to interpose a layer of rubber between the house and the brackets, which has been found to be exceedingly effective. The designs submitted have been developed with the aid of Heins & La Farge, architects.

In some of the streets in San Francisco the feed-wires are placed in ducts beneath the surface. This should be done on other existing lines as rapidly as possible, and the requirements rigidly enforced on all new lines or old lines that are to be reconstructed, so that the street obstructions will be limited to the ornamental poles and the trolley and suspension wires.

MARKET STREET DOES NOT NEED A SUBWAY YET

In the first and second headings of your written instructions you directed me to consider the possibility and propriety of constructing subways, primarily under Market Street. With the exception of the lower end of Market Street, where the ground has been filled, and where the present street surface indicates a strong tendency to settle, Market Street presents no extraordinary difficulties to subway construction. Between Montgomery Street and the ferry work would be expensive, and would require heavy piling in order to provide sufficient foundations. West of Montgomery Street a trench would have to be excavated, the existing sewers and other sub-surface structures reconstructed, and the streets repaved on top of the subway.

There are two kinds of subway, either one of which could be constructed on Market Street. The first would be according to the Boston principle, intended to take the surface cars. In Boston, the excessive congestion on Tremont Street, with a width between curbs of only 29.5 ft., as compared with 78 ft. on Market Street, necessitated the removal of the street cars, the interference of which with each other reduced their speed to about 2 miles per hour. The city of Boston constructed a subway at its own expense and then leased it to the street car company for operation on its completion. Such a subway could be constructed on Market Street, beginning, say, at Sansome Street and extending to Twelfth Street, which covers the portion of the city where the greatest volume of passengers is now handled. The cars could enter on an incline in the center of the street at either end, and these inclines could be so arranged, taking advantage of the triangles which widen Market Street at the points named so as not to cut off traffic crossing Market Street at a single cross street. The service of the surface cars on Market Street by this method would probably not be satisfactory to either the traveling public or the store proprietors along the street. Persons traveling in that part of the thoroughfare and desiring to alight at various points, frequently between the streets, and to watch the store windows, could not do so. If a subway were built there would probably arise a demand for a continuation or a revival of the sur-

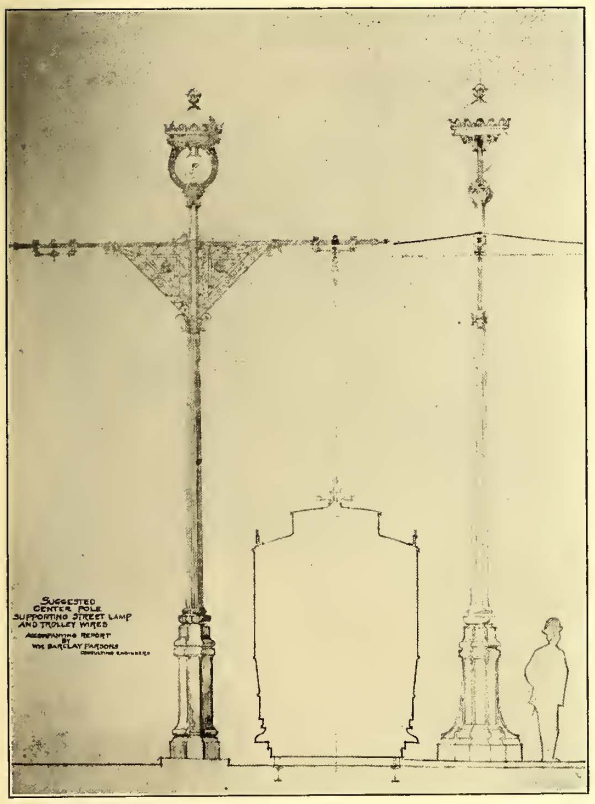
face traffic, which means that the capital invested in the subway would be practically lost.

The second type of subway is the New York type, built as an independent railway and supplementary to the surface lines. A subway of this character, in order to be successful, must have sufficient length and a sufficient tributary population to make it pay. The minimum cost of a subway with two tracks through the city of San Francisco, with stations and equipment, will be at least $2,000,000 per mile. There is not to-day sufficient travel on any one route in San Francisco to pay the operating expenses and interest charges on any such capital investment. The route traversing the greatest territory of travel to-day would be a line starting from the ferry, then following some street like Geary, and extending to Pt. Lobos. The cash cost for such a line having a length of about 6½ miles, without construction profit, would be about $13,000,000. Interest on this sum at 5 per cent, which is moderate when the question of commissions, etc., taken into account, would amount to $650,000 annually, to which should be added, say, $200,000 for taxes and other fixed charges, giving a total annual charge of about $850,000. Assuming a rate for operating expenses of 60 per cent, there would be required $2,125,000 as gross receipts to pay the operating expenses and meet the fixed charges without allowing any profit from operation. At a fare of 5 cents this would mean a passenger travel of 42,250,000 per annum. In other words, one-fourth of the total travel on the whole of the San Francisco system of street railroads would have to be combined on the territory tributary to one street to make a subway pay. Even if a subway were built, all the traffic along the route would not be taken by it, because a large portion of the travel is purely local, moving for a short distance only, to which a subway would be of no benefit.

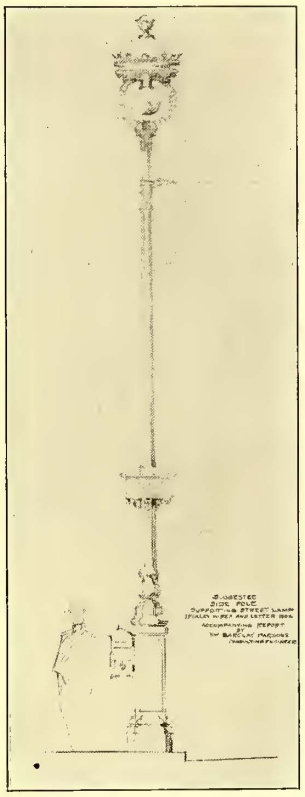
It must be remembered that but one city in the United States has attempted the building of a subway supplementary to surface cars, and that is New York, where traffic conditions are of an extraordinary nature, and not duplicated in any city in the world.

For illustration and for comparison with the previously given statistics for San Francisco, it will be found that the average density of people per square mile in your city is 9190; in the borough of Manhattan, New York, it is 108,030, and while in San Francisco's most populous district the density is 309 per 100,000 sq. ft., there are sections in Manhattan where the density exceeds 1940. As for traffic, your railways show an average of 966,000 passengers per route mile per annum; the similar average in Manhattan, including the horse railways, is 2,400,000, and the greatest traffic line having 12,000,000 passengers per route mile, as against 2,000,000 passengers per route mile in McAllister Street, your heaviest line. The street railways in New York are also supplemented by the elevated and subway railways, the traffic on which is not included in the above. In Europe, where underground railroads have been built, the Paris line is the only one that has been financially successful. The most profitable railroad in London earns only 4 per cent, and the other lines still less, and this on a capitalization that represents actual cost value.

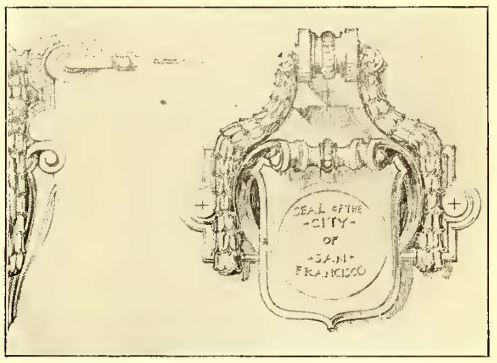
For short distances up to an average journey length of 2 miles to 3 miles, people prefer surface cars on account of the convenience of taking and leaving them at any point, and on account of greater speed when the time required to walk to and from stations is taken into account. A subway to be profitable must have either sufficient length to attract travel or must be fed at one extremity by converging lines and at the other, with a great density of population along the route. Such conditions in San Francisco will probably be met in the future by the development of the very desirable territory to the west and southwest. When the density of population is there sufficient, a subway under Market Street and the Twin Peaks, with branches to the west and southwest, will be the solution. One cannot look too far into the future, and it is suggested that no attempt be made to build a subway along Market Street until such time as the population will have reached the point both in numbers and density as to warrant a permanent decision as to what the proper location is to be.



SUGGESTED DESIGN FOR ORNAMENTAL CENTER POLES FOR SUPPORTING TROLLEY WIRES



SUGGESTED DESIGN FOR ORNAMENTAL SIDE POLE FOR SUPPORTING TROLLEY WIRES



SUGGESTED ATTACHMENT TO BUILDINGS TO SUPPORT TROLLEY WIRES

CERTAIN TUNNELS ARE NEEDED

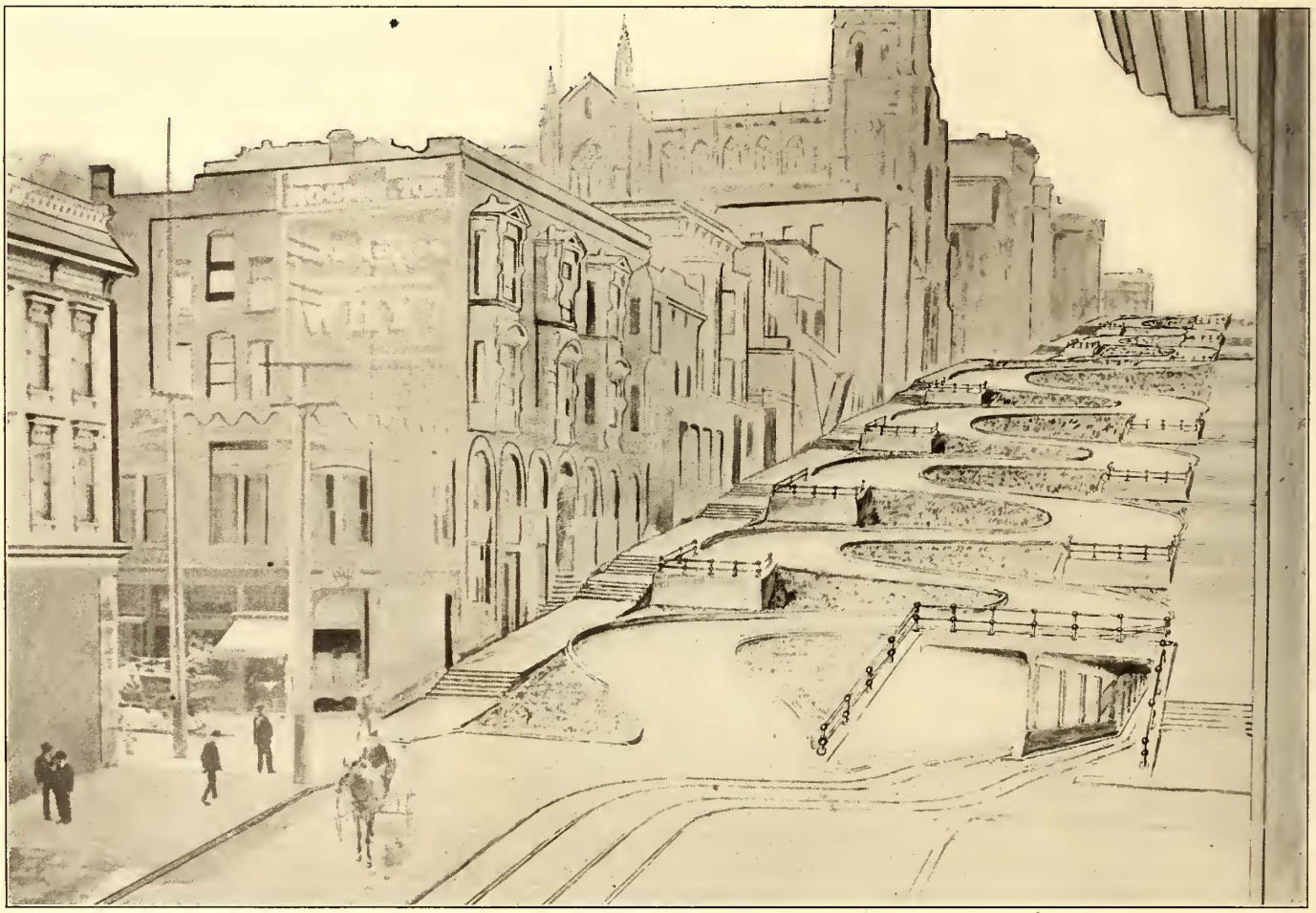
Although I can see no advantageous reason for building a subway under Market Street at present. I am of the firm opinion that subways should be built at once in other parts of the city where they are needed to-day. The suggestions made above call for the elimination of horse and steam, and of the cable lines on all streets except those where the gradients are

so unusual as to prohibit the use of any other motive power than the cable. A properly constructed and equipped electric line can easily ascend gradients of 10 per cent or 11 per cent, and if the length of the incline be not too long, gradients of 12 per cent and possibly 14 per cent. In San Francisco there are many places where the street gradients exceed even the maximum limit. Taking streets on which railroads are now laid, there are many where the surface grade rises at a rate exceeding 14 per cent.

Of these streets, six cross Nob Hill. Passing them for the moment, the Hyde Street line requires a cable on account of the incline on Russian Hill, and on Jones Street for the block between Pine and Bush Streets. If the Hyde Street line were relocated at the northern end so as to avoid crossing Russian Hill at the center and were continued on Hyde Street southerly to Bush Street and thence to Jones, the excessive gradients would be omitted entirely. The Hayes Street cable can be done away with by regrading the summit at Alamo Square at the intersection of Hayes and Pierce Streets, which would make the street gradients convenient for all traffic on both Hayes and Pierce Streets, and would be a decided benefit to the adjacent property. The Powell Street cable can be done away with by carrying the Powell Street line on Stockton, the adjacent street, from Sutter to Sacramento, and then continuing the Powell Street line on Powell Street from Jackson Street to Montgomery Avenue, thus avoiding the sharp hill between Union and Green Streets. The Castro line south of Twentieth Street would probably have to remain a cable line, and if the balance of the road were made electric a transfer could be made at Twentieth Street to surmount the hill beginning at that point.

For the elimination of the gradients on Nob Hill, I would suggest that the hill itself be tunneled, beginning on the west at the east side of Hyde Street and running to Dupont or Mason Street on the east. For the present two such double-track tunnels would seem to be ample, one located under California Street and one located to the north of it, under, say, Jackson Street, or such other street as may seem more desirable. Tunnels of this character cost less to construct than the accepted type of subway, for the reason that they are so deep as not to interfere in any way with sewers, water and gas pipes, thus saving the cost of removing and rebuilding such underground obstructions; and in the case under discussion, there would not be involved any additional cost for equipment, which, in the construction of underground subways, forms a very important item of the total cost.

The tunnel on California Street would extend from Hyde Street to Dupont Street, and have a length of 3290 ft., while the one under Jackson Street would extend from Hyde to Mason, and have a length of 1856 ft. With one station on each tunnel,



PERSPECTIVE PLAN, SHOWING SUGGESTION FOR TERRACING ROADWAY IN HILL DISTRICT, SAN FRANCISCO

such stations to be equipped with elevators, the total cost of the two tunnels would not exceed $1,200,000.

These tunnels would have ample capacity for carrying all the cars now run on six lines. The present combined maximum schedules call for 120 cars per hour in each direction. If they were run through two tunnels it would mean an interval of 1 minute upon each track in each direction. This interval can be greatly reduced in tunnels, where there would be no interference. In these tunnels the California, Sacramento and Clay Street lines would be combined in the California Street tunnel; and the Union, Jackson and Washington Street lines in that under Jackson Street, suitable connections at both ends of the tunnels being arranged to restore the various services to their respective routes. In order to serve the population on top of Nob Hill, stations should be constructed in the tunnels and equipped with elevators and staircases running from the platforms to the surface of the streets. If two tunnels were built these stations could be placed at alternate streets, so that traffic going north and south on Nob Hill would not have to

walk more than one block in either direction to get a car at the terminal points or at intervening stations.

CABLES SHOULD GO

By means of these tunnels and the relocation of small portions of the Hyde and Powell Street lines and the regrading of the Hayes Street line at one point, San Francisco can do away with the antiquated cables and adopt in such streets an improved form of traction that will give a higher speed than is now possible, and so reduce the time of transit from, say, Sansome Street to the Golden Gate by at least 15 minutes. An inspection of the population map will show at a glance that the improved service would reach the district most in need of it, and where the greatest volume of traffic originates. It will also furnish a decided measure of rapid transit to San Francisco's great pleasure resorts, the Golden Gate Park and the ocean beach at the Cliff House, and to the rapidly growing district lying north of the park. This seems to be the portion that for the moment first requires an increase of facilities.

In this discussion I have followed the suggestion contained in your letter of instruction, and have disregarded differences in line ownership, and have treated the several systems as capable of being combined, at least for mutual benefit in operation.

TERRACES AND WINDING ROADS FOR THE HILL DISTRICT

The report then outlines a comprehensive scheme for opening up several of the hill streets now too steep for vehicle traffic by running the roadways up the grades in a series of winding inclined terraces on gradients that will enable horses to climb and descend easily, and permit wagons to stop in front of every house. Many of these houses have never had a wagon in front of them, but deliveries are made from the cross streets above or below. In conjunction with the plan for terracing the roadways, the report includes a scheme whereby the sidewalks would be reconstructed to the new grades, and to compensate for the difference between the gradients of the various terraces, short flights of easy stairs would be introduced, as shown in the perspective sketch reproduced in this connection.

The report concludes with the following summary:

First—The transportation system of San Francisco should be made uniform with the greatest elasticity of operation, and to this end cables, steam engines and horses as motive power should be abolished, and one system of traction should be introduced.

Second—Taking into account the present state of the art, the fact that the greater part of San Francisco's railways cannot be otherwise changed, and for operative reasons, this system is the overhead trolley.

Third—That arrangements should be made to extend the railway system to parts of the city not now equipped with railways so as to make place for additional population within the city limits.

Fourth—That all new trolley lines be built with overhead construction greatly superior to that now in use in either San Francisco or other American cities so as not to disfigure the appearance of the streets, and all feed-wires be placed under ground.

Fifth—That for the present the construction of a subway on Market Street be postponed.

Sixth—That two tunnels be constructed under Nob Hill, permitting the removal of the cable lines, and that such tunnels be built by the street car companies or by the municipality and leased to the companies.

Seventh—That one or more inclined terraces be constructed on the eastern slope of Nob Hill, so that horses with wagons or carriages may ascend and descend freely.

The Lowell & Fitchburg Street Railway Company has petitioned the Massachusetts Railroad Commissioners to issue $240,000 5 per cent 20-year bonds to defray the cost of its road and equipment.

THE NEW EMPLOYEES' THEATER OF THE EAST ST. LOUIS & SUBURBAN RAILWAY COMPANY

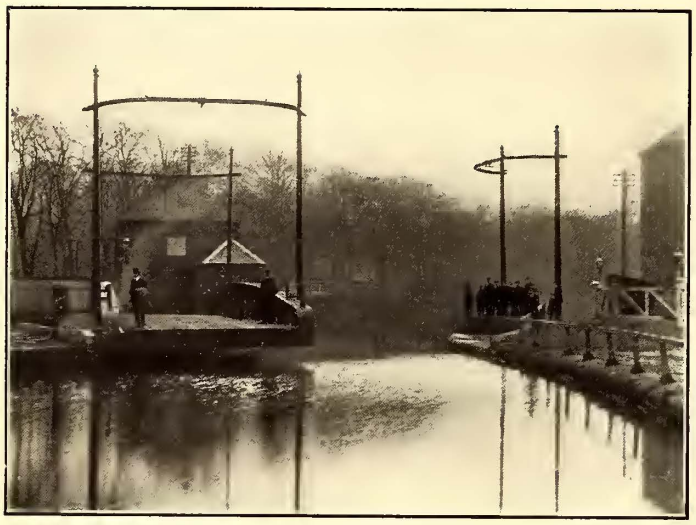
The subject of supplying means of entertainment and instruction to employees is receiving more and more attention from managers of properties employing several hundred men. Reading rooms, billiards, bowling, etc., are now not uncommon adjuncts of modern car houses and shops, but the East St. Louis & Suburban Railway Company seems to be the first to provide a fully equipped, though small, theater for the use of its employees. The conductors' and motormen's room at the shops in East St. Louis was a room about 30 ft. x 75 ft. in size. Back of this are the toilet and bathrooms. At this end of the room a 20-ft. x 30-ft. stage was built of regulation height from the floor with a movable section to its floor which is removed, when the stage is not in use, for passage way to the bath and toilet rooms. By the use of a screen at the back of the stage the washroom becomes a very acceptable dressing room for the use of performers. All the requirements of a modern stage in the matter of footlights and other light effects have been supplied, as well as suitable flies, scenery, drop curtain, etc. All material and a portion of the labor in building the stage and producing the light effects, etc., were furnished by the company, a large part of the labor, however, being contributed after working hours by employees of the line, machine and shop departments. The seating of the theater is with ordinary chairs, furnished by the company. On account of the enthusiastic assistance of employees in voluntary work on stage and settings, the outlay for the company has been comparatively small.

The theater has been named the "Winstanley Auditorium," because of the location of the shop and shed buildings in a section of East St. Louis commonly known as Winstanley Addition. Its management is vested in a committee of five, consisting of the general passenger agent, superintendent of transportation, master mechanic, purchasing agent and the president of the conductors' and motormen's local. This committee fixes rules for use of the Auditorium, dates of performances, etc. Any ten employees of the company desiring to give an entertainment will be given any open date. All entertainments are free of cost to the audience, which, however, is restricted to employees and their families. Admission is by ticket on account of limited capacity, the tickets being distributed by members of this committee and heads of departments, who make no distinction as to any particular class of employees, "first come first served" till tickets representing the capacity of the theater are all issued. To meet miscellaneous expenses of costumes, rent of piano, etc., the company places at the disposal of the committee a moderate monthly allowance, so that those directly connected with the preparation of entertainments will not incur even a small personal expense.

The interest taken in the project by the employees has proved very great. The first general entertainment was given Monday evening, Dec. 11, when the young ladies from the general offices gave a vocal and instrumental concert, followed by stereopticon, phonograph and moving pictures, under the direction of the manager of the local electric light company. Friday evening, Dec. 15, the engineer of maintenance of way and the roadmaster gave an exhibition of hypnotism and mind reading which would do credit to professionals. On Thursday evening, Dec. 21, "The Interurbans" gave a minstrel performance that was par excellence and had to be repeated the following evening for the benefit of those unable to obtain tickets for the first performance. Every available seat is occupied at each entertainment, and the theater promises to be a source of much genuine recreation and amusement throughout the winter season for employees of the company. The amount of latent dramatic, psychic and musical talent among the employees of the company was not appreciated till the little theater gave opportunity for its development.

THE TRAMWAY SYSTEM OF FALKIRK, SCOTLAND

A description was published in the issue of Dec. 9 of the Leith tramways. The town of Falkirk, which is not far from Leith, being close to the Firth of Forth and about equi-distant from Edinburgh and Glasgow, is also the possessor of a new electric system. Falkirk lies in the midst of a thickly populated district, and has for many years been a busy manufacturing center. The route of the tramways, which have recently been constructed, is a circular one, and comprises in all some



THE CAMELON SWING BRIDGE OPEN

7 miles of track. The general contractors were Bruce Peebles & Company, with J. G. White & Company sub-contractors for the track.

The rails, which are laid to a 4-ft. gage, weigh 90 lbs. per yard, and conform to the British standard No. 1 section and specification. They are laid in 45-ft. lengths on a 6-in. bed of 6 to 1 concrete. The joints are made with 24-in., six-bolt angle plates. The bonds are of the Neptune type, No. 0000 section, and the rails are cross-bonded at every 45 yds. The crossings and all special work are Hadfield's manganese steel. The radius of the sharpest curve is 48 ft. The route is hilly, but the grades are on the whole not severe, the worst being 6½ per cent for a length of about 300 ft.

The overhead construction is of the bracket-arm type on all sections, with the exception of about ¾ mile of span wire, which is supported in part by poles and in part by rosettes. There is no center-pole construction. The side poles are in three pieces, and stand 24 ft. high from the ground; the length of bracket arm varies from 8 ft. to 16 ft. The poles are of four classes, weighing, respectively, 1000 lbs., 1100 lbs., 1234 lbs. and 1400 lbs. The trolley wire is of No. 0000 section, and guard wires are used to some extent. The car house has six tracks, and at present accommodates eighteen cars, though there is room for more. Pits are provided beneath four of the tracks.

The cars, which number eighteen, are all single-truck double-deckers, without roof covers, and an illustration is presented to show the general type. Their dimensions are as follows: Length over fenders, 28 ft.; over all width, 6 ft. 6 ins.; wheel base, 6 ft., and gage, 4 ft. The electrical equipment was supplied by Bruce Peebles & Company, Ltd., and includes their most recent types of motors and controllers. A novel feature

STANDARD DOUBLE-DECK CAR CLIMBING A GRADE ON THE LINE OF THE FALKIRK & DISTRICT TRAMWAYS

has been introduced in the motors of this firm by providing the armature bearings with ring lubrication. A check is fitted above the ring to prevent its chattering when passing over switches. Ordinary pad lubrication is used for the axle bearings. The motors are rated at 30 hp each.

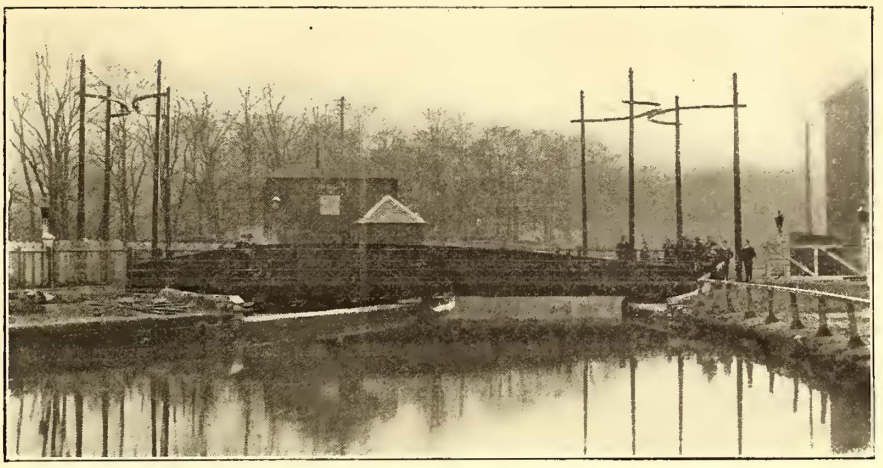
CAR HOUSE OF THE FALKIRK & DISTRICT TRAMWAYS, SHOWING IN PARTICULAR THE TYPE OF ROOF CONSTRUCTION

The controllers are of the magnetic blow-out type, and have four series, four parallel and six brake notches. Hand and rheostatic brakes are fitted to all cars.

The power supply for the tramways is obtained from the Bonnybridge station of the Scottish Central Electric Power Company, recently erected and equipped throughout by Bruce

Peebles & Company. The power is transmitted at 3300 volts, two-phase, 50 periods, to a sub-station, the interior of which is illustrated. The sub-station equipment includes two Peebles-la Cour motor converters, which are each of 200-kw nominal capacity, but each can readily take an overload of 100 per cent for short periods, so that at present one set can take the tramway load. Largely owing to the fact that they are wound twelve-phase, these machines are very stable in parallel, while owing to their special construction they operate as satisfactorily on the 50-cycle circuit as rotaries do on 25 cycles. Furthermore, the direct-current voltage can be varied by shunt regulation independently of the a. c. voltage, a great advantage over the rotary converter system. The sub-station equipment also includes negative boosters and, of course, a high and a low-tension switchboard; there is no battery.

Perhaps the feature of most special interest on the system is the two electrically-operated swing bridges. Each bridge is operated by a motor-driven winch, whose power is transmitted to the bridge by means of a wire rope running over guide pulleys. In case of necessity, the motor can be thrown out of gear and the winch operated by hand. The bridges turn on rollers on a circular turntable, and are pulled around by the wire rope; they can be opened or closed completely in 40 seconds. The turntable is not in the middle of the bridge, but on the bank, the overhang being, of course, compensated.



THE CAMELON ELECTRICALLY-OPERATED SWING BRIDGE

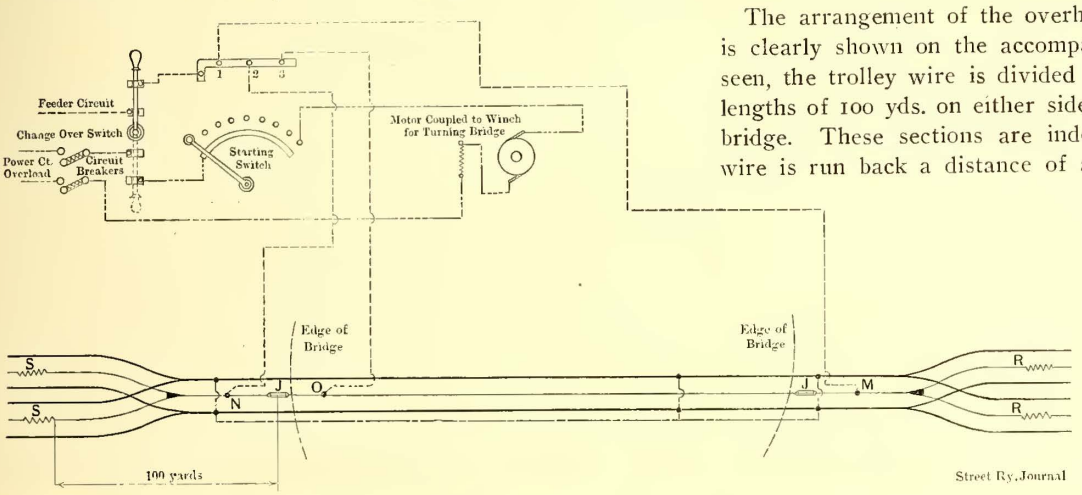
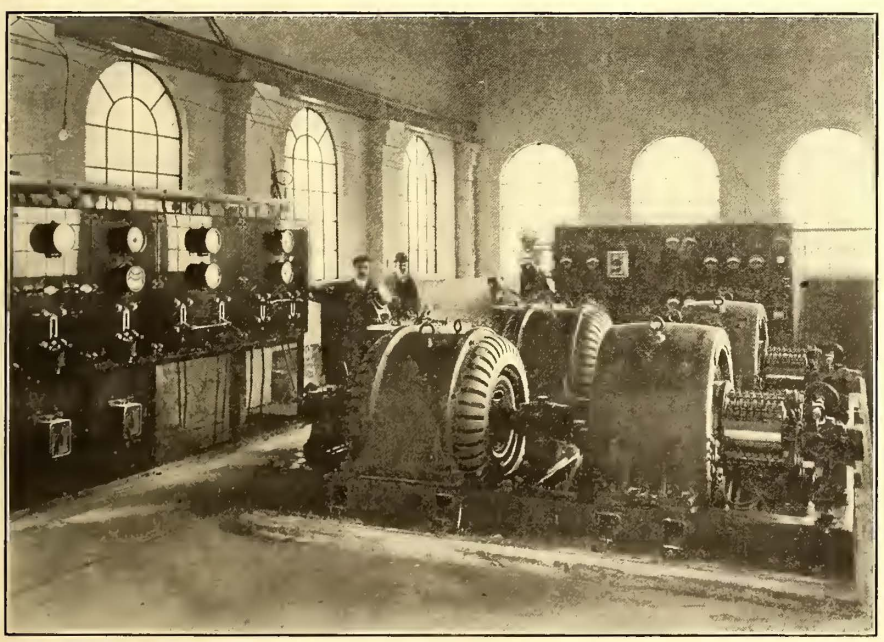


DIAGRAM OF CONNECTIONS AT SWING BRIDGE

The arrangement of the overhead equipment on the bridge is clearly shown on the accompanying diagram. As will be seen, the trolley wire is divided into three sections, viz., two lengths of 100 yds. on either side and the short length on the bridge. These sections are independently fed. The trolley wire is run back a distance of about 50 yds. from the bank as single wire, and then branches off into double line at the frogs.

Section insulators *S* and *R* are placed beyond the frogs 100 yds. on either side of the bridge, thus isolating the total length of line between *S* and *R*. The three lengths of line thus isolated from the rest of the system are fed at the points *M*, *N* and *O*, which are connected to a single-pole, double-throw switch in the motor house. The lower contact of this switch feeds the bridge-operating motor, while the switch center is connected to a positive power feeder. When it is desired to turn the bridge, the switch is thrown to the lower position, cutting off current from the overhead wire between section insulators *S* and *R*. Automatically-operated gates at either end of the bridge interlock with derailing switches some 20 yds. back, so that a car running by momentum with disabled brakes would be derailed. It will be seen that for a car to run into the canal is a physical impossibility.

As stated, Bruce Peebles & Company were the bulk contractors for this installation. Messrs. Harper Brothers were the consulting engineers, A. A. Campbell Swinton was electrical adviser, R. D. Munro was consulting engineer for the bridges and Messrs. Bramwell & Harris were engineers for the sub-station, which was supplied by the Scottish Central Electric Power Company.



INTERIOR OF SUB-STATION, WHERE CURRENT IS CONVERTED FOR USE ON THE FALKIRK & DISTRICT TRAMWAYS

The West Penn Railways Company has issued a neat, 1906, calendar, having for its center piece an excellent illustration of the company's power house and surroundings.

THE USE OF ALTERNATING CURRENT FOR HEAVY RAILWAY SERVICE

BY B. G. LAMME

In the electrical field, as in all others, there is a tendency to look at the immediate future development rather than to consider the more distant work. In consequence, it is general practice to adopt those systems and types of apparatus which meet the immediate requirements rather than those which will be most suitable at some later period. In consequence, any radical development or revolutionary departure from standard practice is met by the fact that it must conform, to a great extent, to conditions already existing. Only in rare cases is the old type rejected and something newer, but with greater possibilities, chosen. The first Niagara power plant is an example of the latter case. Here the engineers rejected the standard high frequencies and boldly chose 25 cycles. There is no doubt now as to the wisdom of the choice of low frequency, although there may be differences of opinion as to what is the best low frequency. The frequency of the Niagara plant had a very great influence in deciding the frequency for other large power plants, and its effect upon the development of the larger electric railway systems of the past eight or ten years is inestimable.

But in most cases, the lines of growth have been along some established system, and immediate necessities have generally carried such development beyond the legitimate limits of the system. In consequence, what was the most economical and least costly system at first, often becomes the costliest in the end. In attempting to correct such unavoidable mistakes, some very badly mixed systems have come to the front. Some of these have no function except to bridge over the gap between the old and the new. Also, in attempting to fit new methods to old ones, the problem is much complicated, just as it is harder to reconstruct an old machine for some new requirement, than it is to build a new machine throughout.

In the electric railway field the conditions are those indicated above, and any new system, no matter what an advance it may represent, must be, for a while at least, adaptable to present conditions.

Until a comparatively recent time, the entire electric traction work has been carried out by means of direct-current equipments on cars and locomotives. In the early days of electric traction the usual voltages on the car equipment was 450 to 500. This has increased very gradually until 600 to 650 is now in rather common use. However, this increase in voltage has been in no way comparable with the increase of service and extension of lines. In consequence, many years ago the direct-current transmission system for feeding the car equipments reached its limits, and it was necessary to adopt alternating currents for generation and transmission with transformation to direct current near the points where the power was to be utilized. As the traction systems were extended the number of transforming points was increased. In those cases where the service is comparatively frequent or fairly constant, such systems have operated in a very satisfactory and efficient manner. But where the load is very intermittent, such a system is not particularly efficient, for the transforming machinery may be operating for relatively long periods at practically no load, and for short periods at extremely heavy loads. Such a system, therefore, is well adapted for service in cities and immediate suburbs, but is at a considerable disadvantage on infrequent interurban service comparable with present steam conditions.

The present direct-current traction system has accomplished wonderful results, and it would be foolish for anyone to attempt to discredit it. However, there are limits to its application, and it would be equally foolish not to recognize them. The most important limit is the low direct-current voltage which has been used heretofore. The present method of overcoming this is by increasing the number of transforming stations and by vastly increasing the expense and complication of the system as a whole.

Future development in the heavy railway field appears either to be limited to the direct-current system with alternating-current transmission and sub-stations with machinery for transforming to direct current, or to a system supplying alternating current directly to the trolley wire and with equipments on the cars which can either use alternating current or which can transform to direct current.

If the present direct-current system with its transforming sub-stations is to be retained, then the future development must lie in the direction of increasing the direct-current voltage on the trolley and car system. This has been seriously suggested by Mr. Sprague and others from time to time, and undoubtedly many have wondered why it has not been carried out extensively in the past. It is no doubt generally assumed that this would have been done long ago unless there were some very serious reasons for not doing it. Such reasons are well known to those who are familiar with the difficulties which have been encountered with each comparatively small increase in voltage over our usual practice on the direct-current railway system. About fifteen years ago, 500 volts was usual, while at the present time 650 volts is rarely exceeded in regular service. It has been stated that the present 500 or 600-volt system is an arbitrary standard, and that there is no particular reason for retaining such a standard when occasion calls for higher voltage. However, as it has taken about fifteen years to obtain an increase of about 150 volts, while there has been good reason for years for going much higher, it is evident that something more than the mere adherence to a standard has prevented the use of higher d. c. voltages. Considering the willingness of manufacturers of electric machinery to make radical departures in other lines of apparatus, there is ground for belief that long ago they would have taken steps in the direction of increased direct-current voltage, if their experience had indicated the feasibility of doing so. In the alternating-current generation and transmission field enormous strides in increase in voltage have occurred from year to year; and alongside of such advances, the slight increase of approximately 150 volts in the d. c. railway field would seem absurd if there were not some fundamental reasons to account for it. As 1500-volt direct-current equipments have been talked about to a considerable extent in the past year or two, it would probably be of interest to many to know what difficulties could be expected with such a relatively large jump above our present practice. I will therefore mention some of the troubles which have been encountered in increasing from 500 to 650 volts, and this will furnish an indication as to what designers would expect if very much higher voltages are used. There have been isolated instances where high direct-current voltages have been used on car equipments, but in general it has been found that 600 to 700 volts represents the practical limit with present designs of apparatus. The difficulties in designing direct-current railway apparatus for higher voltage are not due to lack of ability to construct a railway motor which can be wound for 1500 volts, but largely in certain operating conditions found principally in railway service. The question of high-voltage control systems, high-voltage rotary converters, or motor generators, as well as high voltage on the motors themselves, must be considered.

In the direct-current railway motor, one of the most difficult conditions to be met is the tendency to occasional flashing. This is particularly found in the larger motors for heavy, high-speed service. On a small motor a flash may not be very destructive, but the larger the motor the more serious the difficulty becomes, as a flash may put the motor out of service.

In fact, in most cases it is only the efficiency of the control system and circuit-opening devices which saves the motors. It would undoubtedly be much more serious on higher voltage motors. On 500 volts it is seldom noted, but on 600 or 700 volts it appears to be much more frequent, even though such higher voltage motors are designed with a proportionately larger number of commutator bars, larger size of commutator, etc. This flashing is liable to occur when the circuit of the motor is opened momentarily and then closed again with the motor remaining connected across the circuit. If the magnetism of the motor has an opportunity to die down during the period that the current is off, then the first rush of current when the circuit is again closed will not build up the field as quickly as the armature. The result is an enormous rush of current until the armature counter e. m. f. rises, this current rush being accompanied by great field distortion, with consequent change of lead. This is itself is sufficient to account for many cases of flashing. In late designs of motors it is common practice to remove, as far as possible, all secondary or closed circuits around the field, in order that the field magnetism may build up more quickly. However, the solid yoke of the usual type of d. c. motor forms, to some extent, a secondary circuit retarding the rise in field magnetism, and also the armature coils immediately under the brushes form secondary circuits which may have enormous currents momentarily set up in them. These secondary circuits may cause momentary "spitting" or "blazing" at the brushes, and this latter action may also assist in starting a flash. Experience has shown that, with all possible damping effects removed from the field of the ordinary direct-current motor, there still exists a tendency to flash under certain conditions, particularly when the cars are operated on a trolley system which has considerable inductance, such as one with circuits largely of iron, conveying very heavy currents. In such a system, any sudden reduction in the current is liable to produce momentary voltage rises which may bring any motors connected across the system up to the flashing point, and this action has apparently been responsible for certain troubles in large systems. If, however, the normal voltage is raised to 1500 across the motors, experience tends to show that the above difficulties would practically prohibit their use if the present types of construction are retained.

There are certain ways in which this flashing tendency in high-voltage motors could be suppressed, but these involve very radical changes in the design. For example, they could be made entirely with laminated magnetic circuits with no closed secondary paths and no low resistance secondary circuits in the armature winding. The field would be provided with neutralizing or so-called "compensating" windings, which practically neutralize the magnetizing effect of the armature. In such a motor the field magnetism would rise almost instantly when the circuit was closed and the rush of current would be relatively small. Also, such current as did flow would produce practically no distorting effect on the field and but little change in lead. The armature coils, short circuited at the brushes, having no low resistance path, would have no heavy secondary current set up in them, and consequently there would be no particular tendency to undue sparking at the first current rush. Such a motor, when running at high speed, could be thrown directly across a high-voltage circuit without resistance in circuit, or could even be reversed without resistance, with no injurious effects as regards flashing. Such a motor would therefore form an idcal one for direct-current service. However, it would be relatively expensive to construct, and if wound for high voltage, would require a comparatively large number of turns on the armature and compensating windings. The field winding, however, could have comparatively few turns, as a stiff field is not required to prevent distortion.

The ideal type of direct-current motor which I have just described is, however, the one which has been developed for use with alternating current, and such a motor, with but relatively small expense, could be designed to make a rather good machine for operating directly on alternating-current circuits of low frequency. Therefore, in constructing the ideal motor for operating on high voltage direct current, we come directly to the construction which permits us to do away with direct current altogether.

Another feature of the high-voltage direct-current system which should be considered, is the question of the control system. I have no doubt whatever but that a 1500-volt control system will be more costly than one for 600 volts, and it will also be more liable to break-downs. While its construction is not impossible, yet I believe that a 1500-volt direct-current control will be much more troublesome to operate than a 600-volt control.

Passing next to the sub-stations or power house required with a high-voltage d. c. system, we find that it is necessary to use high voltage direct-current generators or rotary converters. A 1500-volt direct-current generator may represent a permissible design and it may not be unduly expensive. However, a high voltage rotary converter presents some problems which are not found to the same extent in the present low-voltage machines. A good non-hunting rotary converter possesses an inherent tendency to flash under certain conditions. It is found that on certain conditions a short circuit, momentary or otherwise, on the direct-current system, sufficient to open the circuit breaker at the rotary station, may cause the rotary converters to flash at the commutators. This effect appears to be dependent largely upon the alternating-current transmission system back of the rotaries. For instance, the d. c. short circuit may produce a momentary drop in voltage on the a. c. system supplying the rotary. The moment the d. c. circuit breaker opens and the short circuit is removed, the a. c. voltage at once tends to rise to normal value. The rotary, however, has had its counter e. m. f. lowered by the short circuit, and there is therefore a tendency to produce a momentary rush of current when the a. c. voltage rises. This rush of current momentarily changes the lead and may cause a flash at the commutator, which again produces a drop in the a. c. system, tending to reduce or stop the flashing. The result may be a series of flashes following each other quickly, and in some cases this is only stopped by cutting the machine out of circuit. It has been the practice in some cases to install automatic circuit breakers in the alternating side to get the machine out of circuit when this flashing occurs. However, the time required to synchronize is generally considered such an objection that the risk of flashing is considered the lesser evil and the a. c. breakers are omitted. Cases have been noted where several rotaries were connected to the same system, some operating without load, when a short circuit across one of the loaded rotaries has caused the empty ones to flash, indicating clearly that this effect comes through the alternating system.

Experience has shown that this possibility of flashing increases rapidly with increase in voltage. It usually is not troublesome in city and suburban plants where the a. c. transmission drops are comparatively small and where the loads are comparatively steady. The trouble increases in those cases where the line drop is liable to be rather large, and where the service is rather infrequent and the load fluctuates over a wide range. On account of this difficulty, it is generally not feasible to install rotary converter capacity in the sub-stations corresponding only to the average load, but it must be more nearly comparable with the maximum load, in those cases where the service is very infrequent and the load fluctuates violently. With voltage of 1000 and 1500 on rotary converters, this flashing tendency would be enormously increased and might even prohibit the use of this class of machinery.

It has been noted that it seems to be, to a great extent, independent of the frequency, the number of commutator bars, size of commutator, etc., just as the flashing in a railway motor seems to be, to a certain extent, independent of the number of commutator bars and the size of commutator.

As to the construction of 1500-volt generators for constant potential service, while this may not be entirely impracticable, yet it is not a particularly easy problem to design them for railway service. It has been stated a number of times in the past four months that the construction of high voltage d. c. generators is not a difficult problem, as instanced by the 3000-voltage generators of the Thury constant-current system. However, it should be borne in mind that a 3000-volt constant-current machine represents a much easier condition as regards operation than a 1500-volt constant potential machine, such as would be required for railway service. In this country 6000-volt d. c. constant-current machines have been common practice for years, yet the builders of such machines are well aware of the fact that the constant-current feature is a very important condition in their construction and operation. A flash on a constant-current machine is not especially destructive, as the current does not rise to a dangerous point. On a constant-potential machine, however, the current may rise to an enormous value and its destructive effect may increase rapidly with increase in voltage, as the energy expended in the arc will be greater. Experience has shown that on 650-volt machines a flash is more vicious than on 500-volt machines. The tendency to flash will also undoubtedly increase with increase in voltage. Further, it is not fair to compare a railway machine with one terminal grounded with a high-voltage machine in which both terminals are insulated. In railway service, any momentary flash which reaches to any of the neighboring parts of the frame would short-circuit the machine unless the frame and parts are entirely insulated from the earth, while this would not be true in the case of a generator with insulated circuits. Taking all things into account, the design of a first-class 1500-volt d. c. railway generator with one terminal grounded presents such possibilities for trouble that those designers most able to construct such a machine are the ones who would raise the greatest objection to doing so.

The above is simply given to show that while it is easy to talk about the use of 1000 and 1500 volts on direct-current railway service, yet there are very serious difficulties which are encountered by the designers of such machinery. I have personally been in direct touch with the designs of direct-current railway motors, railway generators and rotary converters for many years, and am therefore familiar with many of the troubles which will have to be overcome with the high voltage direct-current system. But even if such difficulties are surmounted in 1000 or 1500-volt apparatus, we have simply extended the field of operation of the direct-current apparatus, but are yet far from the solution of the general railway problems. It would simply be a small step in advance of what we have now in the field, and the question of collection of current would still remain unsolved to a great extent. The present third-rail system, while it has operated admirably on 600 and 700 volts, would present serious objections on 1500 volts, and it is the opinion of many that if such voltage were to be used, then the overhead trolley system would also be used. A 1000 or 1500-volt overhead trolley system, while it is operative under many conditions, is far from being adequate for the general problems of traction which are to be met at some future time.

It has been recognized for a number of years by our leading engineers that the extension of electric traction to heavy railroad service is dependent to a great extent upon the use of much higher voltages than appear to be practicable with direct current. A number of methods of utilizing high voltage alternating current directly on the trolley have been more or less completely developed. One of these is the now well-known three-phase system with induction motors, variable speed being obtained by rheostatic control combined with cascade connection or with changing the number of poles on individual motors. This system operates successfully under certain conditions, but many engineers do not consider that it furnishes the proper solution of the general railway problem in this country. With this system, the two overhead trolley wires are at different potentials, and the problem of current collection, crossovers, etc, becomes increasingly difficult as the voltage is raised. In consequence, it has not been advocated extensively for voltages higher than 3300. This is believed by many to be entirely too low a limit for the future railway field, and therefore this system will be, to a certain extent, in the same class as the direct-current system, from the fact that its voltage is limited.

Several systems have been developed for using single-phase alternating current for railway service. The great advantage of the single-phase is found, not in the characteristics of the motors themselves, as much as in the fact that with a single overhead wire there seems to be almost no limit to the voltage which can be used. Thirty-three hundred volts has proved to be extremely easy to handle; 6600 volts has also been tried out in a perfectly satisfactory manner; 11,000 volts has been adopted on at least one road, and I have no doubt whatever but that 22,000 volts will be given tests in commercial service within a reasonably short time; in fact, the Swedish Government tests are arranged to cover 18,000 volts on the trolley. It is therefore evident that the single-phase alternating current furnishes the solution of the transmission and trolley problems, for the complication and cost do not increase greatly with increase of voltage.

The success, however, of a single-phase trolley system depends entirely upon the apparatus for utilizing the current. A number of motor systems have been suggested, and some of them have been given a more or less complete trial. Among these may be mentioned the motor-generator type for supplying direct current to motors on the car. This is operative, but means much additional weight and cost, and is practically limited to locomotives. There is also the Arnold system, where a single-phase motor, either synchronous or induction, is operated in connection with pneumatic apparatus on the car. A third system, and the one which has been given the greatest development, is that in which some form of the series commutator type of motor is used. This latter forms what is now known as the single-phase alternating-current system.

It should be borne in mind that it is not any particular merit of the single-phase commutator type motor which constitutes the advantageous feature of the single-phase system, but rather the successful development of such a motor permits the retention of most of the advantages of the present direct-current system while many of its limitations are removed. The motor itself, in its characteristics, closely resembles the direct-current series railway motor, and this is considered one of the principal merits of the single-phase commutator type motor. Having these characteristics, the motor is susceptible of economical speed control, just as in the case of the direct-current motor, but this feature can at once be taken advantage of in an alternating-current system, due to the fact that voltage variation can be simply and economically obtained as soon as we are dealing with alternating currents. The development of such a motor, therefore, at once permits us to use any desired voltage on the trolley system, and this can be transformed to any suitable lower voltage for the motor system, and such voltage delivered to the motor system can be varied economically over any desired range. Herein lies the true merit of the single-phase system and not in any inherent superiority of the motor itself. In fact, the motor itself is superior to the direct-current motor in only a limited number of features, while it is inferior in a number of others. The alternating current commutator type

motor is necessarily built along lines which would make a very superior direct-current type of machine, and therefore in comparing the alternating-current motor with the direct-current motor, it is only fair to compare it with what could be obtaincd from the same material and construction properly applied in a direct-current machine. Under such condition the direct-current motor will undoubtedly show extremely good characteristics. In fact, certain types of single-phase alternating-current motors now in the market are in reality very fine direct-current machines, and will operate on direct current in many ways more perfectly than any purely direct-current motor now on the market.

As stated before, a direct-current motor designed for very high voltages to operate without flashing would probably approach very closely the design of a single-phase alternating-current motor. Therefore it has been a question with the manufacturers, whether, instead of going to these refinements to obtain a limited increase in voltage on direct current, with the accompanying high-voltage control, high-voltage d. c. generating plants, etc., it would not be advisable at once to wind the motor for alternating current, and thus open the way for the use of much higher voltages and at the same time obtain a low-voltage control system which is of the most efficient known type, namely, variable e. m. f. from transformers.

A single-phase system with commutator type motors, therefore, possesses the following features of prime importance in heavy railway work, namely, very high voltage with relatively small currents can be used on the trolley circuit; low voltage on the control system and motors; a method of control which varies the voltage in an efficient manner; a type of motor with the speed characteristics of the direct-current motor and therefore susceptible of speed control over the entire range from zero to maximum when used in connection with the above-mentioned voltage control. Finally, the motors and control are connected to a low voltage secondary circuit which can be insulated from the main circuit, if so desired. Another feature of great importance is that the motors can be so arranged that they can be operated in a very satisfactory manner on direct current as well as alternating. This latter feature may not be of great importance, except in the immediate future, but at first it is probable that quite a number of the a. c. railway systems will have to operate in connection with existing d. c. plants. In this use of the motors on both alternating and direct current, this system is undoubtedly much superior to the three-phase system, even when the motors of the latter are equipped with commutators.

For heavy railway service equivalent to present steam practice, this system commends itself in many ways. Trolley voltages of 6600 or higher now appear to be necessary for such service. Speed control over any desired range, especially for freight service, is of extreme importance and can readily be obtained with this system. With voltage control and commutator type motors the power consumption at the motors is moreover practically in proportion to the load, and, when running with a given load, at the lowest speeds the power consumption is a minimum. In this feature the single-phase railway equipment resembles the present steam equipments. A further feature of great value from the operating standpoint is that a sudden overload or momentary short circuit does not mean a shut-down of the system for any considerable period of time. As the trolley system is fed from the lowering transformer simply, without interposition of moving machinery, a short circuit will have the effect of lowering the voltage temporarily, and as soon as the short circuit is removed the voltage can rise to normal and the system is at once operative. In the present a. c.-d. c. system, however, a severe short circuit is liable to shut down the system for quite an appreciable period until the sub-station machinery can again be brought into service. Furthermore, with the a. c.-d. c. system the momentary load which can be taken is dependent upon the rotating sub-station apparatus, to a great extent, while with stationary transformers alone an enormous overload can be carried for a short time without deleterious effects. The system is therefore a very suitable one for infrequent and violently fluctuating loads. The efficiency of the lowering transformer is quite high over a very wide range, which is not equally true with the rotating machinery, such as is required for transforming from alternating to direct current.

The number of sub-stations and their distribution can be made to conform to the load conditions to any desired extent. For instance, if there is any point where there will be a particularly heavy pull on the system, such as a difficult grade, then a transformer station can be placed at this point.

Another feature possessed by this system is the ability to increase or extend the service with but a relatively small increase in cost. For example, if the service on the road should be doubled or tripled after it is installed, then the number of transforming stations could be doubled or tripled, if desired, these stations being placed between the older stations. In this way the transmission and the trolley systems could remain practically unaffected. Also, an extension of the system at either end could be accomplished in many cases by simply extending the existing lines, without the addition of feeders along the whole system. In other words, the system could be extended very greatly with a cost in the transmission and trolley systems practically in proportion to the extension.

On account of the comparative newness of the system, the question has been raised from time to time whether single-phase alternating motors of suitable size and capacity can be built for heavy railway service. But as such motors have been built and given severe tests, and are being built in comparatively large quantities, and as those manufacturers with experience in the design of such machinery state positively that they can build such motors, there should be no further question on this point. The question seems to be turning now to the comparative economy of the single-phase system and the direct-current system with transforming sub-stations. This is a question upon which it is rather difficult to give any decided answer, as the results would depend on each individual case. The distribution of the losses are so different in the two systems that it is hard to make any comparison unless a rather complete analysis is made. The efficiency of the single-phase alternating-current motor is necessarily somewhat lower than that of a corresponding d. c. motor; also, there is an additional loss in the transforming apparatus on the car. Furthermore, an additional amount of power is required to operate the a. c. equipment, due to greater weight. The single-phase motors are necessarily somewhat heavier than d. c. motors of same rating, due to a considerable extent to the fact that in the alternating-current motor the steel supporting frame is idle magnetically and therefore constitutes dead weight, while in a direct-current machine the supporting frame or yoke is active magnetically, and therefore constitutes useful material. This, in itself, may represent a difference of 15 per cent or 20 per cent in weight between the two types of apparatus. Also, the lowering transformer on the car or locomotive represents an additional weight over the d. c. equipment. The rheostat required on the d. c. system is, however, omitted on a straight alternating-current equipment, although it will be required when the equipment is used for both alternating and direct current. In other features, however, the alternating and direct-current equipments are not so very different in weight. Taking all these facts into consideration, the alternating-current equipment will probably weigh from 5 per cent to 10 per cent more than the direct-current equipment, and therefore additional power is absorbed in the operation of the car, due simply to this weight. Therefore, as regards power consumption at the car itself, the alternating-current equipment when

running at the same speed as a direct current, requires somewhat more power.

If the system is such, however, that there is very frequent starting, then the alternating-current equipment, using voltage control only, will be more economical during acceleration than will the direct current with its rheostatic and series-parallel combinations. In such cases the difference in economy at full speed may be partly or wholly offset by the better enonomy of the alternating equipment during acceleration. However, this does not apply to any extent to other service where the steps are relatively infrequent.

Passing to the trolley part of the system, it may be noted that with the very high voltage which can be used with the alternating system the trolley losses can be made very low compared with average d. c. conditions. For long lines, the gain in this part may much more than offset the loss in the equipments, and therefore the two systems may be on a par as regards economy beyond the transformer stations.

In the transforming sub-stations the d. c. system requires either rotary converters or motor generators for transforming from alternating to direct current. In addition, reducing transformers are required for changing from the high-voltage feeder system to the low voltage required by the transforming apparatus. The efficiency of a rotary converter when fairly well loaded is very good, but if the service is very intermittent the average efficiency of the rotary converters may be but little over 90 per cent, if that high. With motor-generators, the efficiency will be from 2 per cent to 5 per cent lower than with rotary converters. The efficiency of the reducing transformers in these sub-stations is comparatively high. If the single-phase trolley system is fed from transformer stations, then the transformer losses will be present, and it is only the difference in loss due to the rotary converters or motor generators which should be considered. If, however, the trolley voltage should be so high that it can be supplied directly from the generator, without transformers, then there would also be a gain in efficiency of the single-phase system due to the elimination of the transformers themselves. Even with transformers in both cases, the single-phase system could use one or more large transformers in place of a larger number of smaller units generally used with rotary converters or motor generators.

It may be suggested that with motor generators the motors could be wound for very high voltage, thus avoiding the use of step-down transformers. This can be done in some cases, but it should be borne in mind that the efficiency of a very high-voltage motor is in general 1 per cent to 2 per cent lower than a correspondingly low-voltage motor, and thus the gain in efficiency due to omission of transformers will hardly bear consideration.

Going back to the power house, we find that in most cases the single-phase system requires somewhat less total output that the a. c.-d. c. system with rotary converters or motor generators. This means, therefore, that the efficiency of the single-phase system as a whole is somewhat better than that of the a. c.-d. c. system; about 5 per cent to 10 per cent in most cases. It is this gain in efficiency in the combined system which is important, and not the gain or loss in any particular piece of apparatus. If the single-phase system shows a lower power consumption, with the same service, than the a. c.-d. c., then it is absurd to criticise the lower efficiency of the car equipments themselves.

Considering next the total cost of such a system, we are again confronted by the fact that different results will be obtained in each individual case, but considering the problem in a general way only, the results indicated below have been obtained. The power house for either system will cost very nearly the same. The power consumption in the single-phase system will average slightly less than that of the a. c.-d. c. system, but part of the apparatus in the power house will be more costly if the ideal single-phase system is installed. The generators themselves for supplying straight single-phase current should be somewhat more expensive than polyphase machines used with the rotary converter system. This is due partly to the fact that single-phase machines as a rule are larger and heavier than polyphase machines for the same output, and also to the fact that the regulation characteristics of the two systems may be quite different. In the a. c.-d. c. system the regulation of the generator itself may be comparatively poor and the rotary converters may be compounded to correct for this. In the single-phase generator for railway work, however, all compounding is done at the generator itself, and therefore the machine must have fairly good characteristics in itself. There are also other features in the station which may modify the relative costs somewhat, so that as a rule the power houses for the two systems may be considered as having relatively the same costs. If the power house should represent a comparatively high per cent of the total cost of the system, then this parity in this one large item may mask to some extent the difference in per cent in the remaining items. For instance, if in the other items the single-phase system should cost 20 per cent less than the a. c.-d. c., and the power house equipment should represent 50 per cent of the total cost, then the single-phase system would have an apparent advantage of much less than 20 per cent of the total cost, while with the power house equipment representing a smaller per cent of the total cost, the single-phase system shows somewhat better. The actual figures should be looked at and not the per cents.

Beyond the power house the high-voltage transmission line, if one is used, may represent practically the same cost in either system. In the sub-stations, however, if such are used, the single-phase system may have one or more transformers of relatively large capacity compared with a larger number of smaller transformers with the a. c.-d. c. system. The cost of transformers with the single-phase system should therefore be less. The cost of the rotary converters or motor generators is entirely wiped out with the single-phase system. Therefore this system represents a very considerable gain in cost in the sub-stations. The cost of the buildings themselves can also be reduced as their size can be reduced.

Coming to the trolley system, the high-voltage trolley construction itself may represent a higher cost than the usual direct-current constructions, neglecting feeders. However, when the d. c. feeders are included, the total cost of the direct current part of the transmission system is found to be much higher than that of the high voltage alternating trolley system without feeders. When the car equipments are reached, however, we find the conditions reversed. On account of the construction of the motors themselves, with their thoroughly laminated fields and supporting frames, which represent extra material, the cost is very materially increased over that of the present types of direct-current equipment. Also, the cost of the lowering transformers on the car must be added. If the equipment is to be used for both a. c.-d. c., there will be some extra cost due to added switching and controlling apparatus. Therefore, taking everything into account, the cost of the a. c. equipments is very considerably higher than for corresponding d. c. equipments. However, in general it has been found that this increased first cost of the car equipment does not merely neutralize the gain in other parts of the system, for in the ordinary a. c.-d. c. system the cost of the electric equipments on the cars represents but a small per cent of the total cost of the system, and therefore a large per cent increase in this smaller item will not be equal to a relatively large decrease in cost of some of the larger items. As a rule, therefore, it has been found that the total first cost of the single-phase system is considerably lower than that of the standard a. c.-d. c. system, the difference depending upon individual conditions. Not considering the power house, in some instances this difference

may amount to as much as 30 per cent, while in others it may be as little as 10 per cent.

The above considerations of efficiency and cost have been based on usual conditions of operation as handled by the present a. c.-d. c. system, but in service corresponding to heavy steam conditions there are other conditions entering which affect the comparison of the two systems. For example, the question of economy of speed control should be considered when it comes to freight service, or in those cases where it is necessary to run for considerable periods at other than the normal speeds. With the present d. c. system, between half and full speed, that is, between series and parallel, there is no economical running point, and rheostatic control must be used with corresponding reduction in efficiency. However, with the single-phase system, the number of speeds which can be obtained are directly proportional to the number of voltages which can be supplied from the step-down transformer. As a rule, the number of steps are rather large, and a corresponding number of efficient speeds are obtainable. Therefore, the single-phase system, for such condition of service, is much more efficient than the d. c. system, not going beyond the car equipments themselves. Taking the whole system into account, in such cases, the total efficiency should amount to many per cent better than in the a. c.-d. c. system. Therefore, in any condition where the d. c. system requires any considerable use of the rheostat for regulating the speed, the single-phase system has the advantage in economy as far as the equipment itself is concerned. But under conditions where the d. c. equipment does not require a rheostat the advantage is in its favor. Such conditions, however, would be the exception rather than the rule, in service corresponding to that of the present steam roads.

AN OPEN LETTER TO MR. WESTINGHOUSE

BY MR. SPRAGUE

So your reference to me in your recent letter to "The Railroad Gazette" was "not intended to do Mr. Sprague an injustice"; that is probably the reason why it was written and spread broadcast. Those who have the patience to follow this subject will quite likely reserve to themselves some right of judgment, and will be able to form a correct opinion as to your real motives.

Contrary to your suggestion, I did not forget to mention anything of pertinence or proper public interest, in so far as it concerns my comments on the adoption under existing conditions of a. c. locomotive operation on the New Haven terminal division, but in order to confine myself to that particular case, and to avoid being wrongly, even with apparent reason, put in a position of antagonism to any rational application or development of the a. c. system, I did omit many things which might with entire truth have been said concerning the special difficulties naturally being experienced in that development, and many other things which my official relations would not permit me to say.

But in spite of my moderation you have made references to my contracts which are incorrect as to fact and foolishly untrue in inference. Permit me to correct you as to both, for if the public is at all interested in any personal discussion between you and myself, it might as well know the exact state of affairs.

I have at present a contract with the Sprague Electric Company, an extension of one I have had for a number of years, during which time it was an active competitor of the principal electric companies. By this contract it became the owner of my patents, and it has naturally and very properly restricted me from engaging in rival manufacturing, or advising those who are so engaged.

Further, in part liquidation of a royalty agreement covering the use of the "multiple-unit" system, I agreed to accept an annual payment during the term of the patents covering that system, if living, and required a guarantee that my name should always be used as designating it, not only by the Sprague Company, but by any successor or licensee of it. But whether those patents be used or not, this payment is not affected by a penny's worth, nor by any other act of mine. The contract makes no mention of any railroad corporation, nor is any such intended, and it is a rare order of imagination which would convert the railway and power transmission companies of the country, the customers of the great electrical manufacturers, into corporations which may be classed as unfriendly to them.

This contract, under present conditions, confers upon the officials of the General Electric Company no authority whatsoever, so far as I am concerned, and no man knows better than yourself that I would brook no interference by individual or corporation with my professional opinion or action when engaged as a consulting engineer.

I have in addition a contract with the General Electric Company, a brief one, whose sole provision is a guarantee that the Sprague Company shall fulfill its obligations to me, the chief of which in my opinion is the use of my name in connection with all multiple-unit apparatus, no matter what the details.

Such is the legal status of my contracts, and it is in no sense altered because the General Electric Company is now the owner of the stock of the Sprague Company, or because it may become its successor in the event of that company's assignment or liquidation. I cannot, therefore, recognize your privilege to interpret these contracts in a light contrary to their spirit, or in any manner other than is mutually acceptable to the present parties to them, even though it may serve your personal purposes to do so.

But assuming, despite your forgetfulness and inaccuracy, that in place of the Sprague Company the General Electric Company becomes the principal, by whatsoever official action of the Sprague Company, with what poor grace comes your attack on me when by reason of that very fact, because of agreements between your own and the General Electric Company in force for the past ten years, you would become, under like terms, the direct beneficiary of every patent advantage thereby derived, and the indirect beneficiary by my abstention from manufacture.

You have said that I have a "particular personal interest" in my "own form of control," and thereby attempt to differentiate the apparatus built by your company. You are, of course, aware that I have here no monetary interest whatever in its use, and it would have been nearer the truth had you stated I had a pardonable personal pride in a system absolutely of my creation which has revolutionized electric train operation, a system which you are widely using, and in whose adoption to your special requirements you have the active aid of my former confidential assistants. Were you as careful to recognize the rights and equities of others as you are tenacious in upholding of your own, you would not let an hour pass before directing in this instance the proper recognition of my name, instead of waiting until the slow and tedious process of law may compel such acknowledgment.

The true inwardness—and the littleness—of your reference to me lies in its suggestion that I am not independent enough to pass upon the merits of a proposal submitted to me, or that the New York Central Commission has not accorded your company fair treatment. So far as my friends are concerned, I need no defense, for they know that my engineering instincts rise supreme above any personal interest when acting in an advisory capacity, and the New York Central can best answer whether I have maintained the standard which it exacts from all who serve its interests.

A single fact, and not the only one with which you were

conversant, should have made you more cautious in your reference to me, for you well knew when you penned your letter that, despite your assertion that natural inclination would lead the New York Central Railroad to award contracts, if it could do so on a sufficiently favorable basis, to a manufacturing company whose works are upon its lines, you had been awarded one of the most important contracts in its equipment, that for 27,000 kw of rotary converters, with my full accord and approval.

It is to be regretted that in reflecting upon that Commission you seem to have forgotten its composition. Permit me to remind you that, as one of its members, it has been my pleasure for a considerable portion of the time to be associated with the then vice-president of an organization absolutely controlled by Westinghouse interests, but although we often for a time may have disagreed, in all the deliberations which affected the New York Central interests I have done myself the honor to give him, as I believe he gave me, the credit of recognizing in the highest degree the judicial character of our positions.

As you well know, the decision affecting the present equipment of the New York Central Railroad has nothing whatever to do with future extensions. It was dictated in part by local conditions which are just as distinctive and determinate to-day as when the equipment was decided upon. These reasons have been time and again set forth, and both collectively and individually the Commission has made it clear that its decision was not necessarily to be taken as a precedent, that there was no antagonism to any particular system, and that when the problem of such extensions should come up every possible advantage would be taken of electric developments of any nature and from any source. Hence the attempt to get the New York Central Railroad to abandon matured plans, to terminate its contracts, and to adopt your proposal for a change of its equipment, in so far as such proposal could be influenced by cost comparisons extending to the balance of its system, is without the slightest basis of reason, nor was it helped by estimates which, being wide of the facts, are utterly worthless.

I find myself, with others, wondering what has caused your somewhat rabid general denunciation. Is it a tardy realization of the importance of my letter, now ten weeks old, or appreciation of its truth, or changes in some of the original intentions of the New Haven Company, or difficulties which have manifested themselves on existing a. c. equipments, or in the carrying out of the New Haven projects? Perhaps it was the loss of the Camden & Atlantic City line to a direct-current equipment, or an important single-phase road to a rival, but these are the fortune of war, and a saving sense of humor will prevent an attack of melancholia. Perchance, some coolness in the reception of your ex-parte statements, privately circulated a month ago, and now in part made public, has made necessary an attempt to bolster them up, but in any event your position will hardly be strengthened by over zeal or misdirection of statement, even when illustrated by exceptional cases of electrolysis, easily avoided and having little bearing upon the general railroad problem.

You take personal offense because I have pointed out some of the difficulties which will naturally characterize the progress of the a. c. development, and the special ones which it challenges in a particular case, and have essayed to make it appear that my opinions were dictated by a spirit of special friendliness to another company. Permit me to inform you that I have on frequent occasions stated that whatever excuse there may have been for the enthusiasm of your engineers—and there was much—there would have been little for those of the General Electric Company for making a similar proposal under like conditions, because they, probably even better than your own men, knew the limiting conditions.

Had the New Haven road restricted its equipment, as seemed to many for the time wise, and for the special reasons adopted in a limited territory direct-current operation, it would not, contrary to your statement, have necessarily meant apparatus of General Electric manufacture, for as I have already pointed out, an equal right of construction lies with your own company. Nor, save on the one question of locomotive pooling, was there any need for restriction in the details of apparatus.

I stood in that matter as I hope I may always stand, for what I believe to be the best interests of the public and the electric railroad development, irrespective of any personal interests or business affiliations; and had my criticisms lacked the essential elements of truth and common sense, one would have supposed that in the supreme confidence which you profess you would have been content to have awaited the issue, and to have witnessed my discomfiture and the acknowledgment of the error of my ways and opinions, which I think in that event I am broadminded enough to have made. But I have ample reason to believe that, distasteful as my criticisms may have been to some, when measured by public convenience and safety, results of importance have already been accomplished, and even more are sure to follow.

The charge that the General Electric Company and myself are engaged in a conspiracy to fasten upon the railway world the direct-current system as opposed to the alternating-current or any other particular system unduly enhances my importance, and is an amusing product of imagination, or the result of hysteria.

I must remind you that I was probably the first engineer in this country to recommend, in an official report some fifteen years ago, the general adoption of alternating current for the transmission of power over long distances, and I have not changed my attitude since. I have also to call your attention to the fact that not only have I steadily advocated higher potentials, but several years ago I publicly expressed the desirability of the development of single-phase motors for use on electric railways. And in order that you may not, unchallenged, appropriate to yourself all initiation in this art, I must not forget to mention the late lamented Charles Van Depoele, whose name you may be familiar with, who, in addition to much other admirable pioneer work, some sixteen years ago advocated and patented a method of using single-phase currents on electric railways.

In instructive contrast to your assumption as to my affinities, it is a curious coincidence that at the very time of the issue of your letter I should have committed myself to a belief in the possibilities, and stated my readiness to assume the responsibility under some circumstances, of a d. c. operation at a potential three times as high as your engineers have fixed in making comparisons between the two systems, a potential which, it is proper to point out, has not yet received the endorsement of your own or the General Electric Company. I therefore can hardly be accused of speaking for either in thus taking this public stand, but rather as the representative, as I have always tried to be, of consistent advance by all lines in an art to which I have devoted my life.

You object to healthy criticism, but in your self-constituted position as universal engineering advisor and mentor, has the New York Central, or its Commission or the General Electric Company been free from such? On the contrary, you have been unsparing in predictions of disaster. The use of the particular turbines selected was to be followed by a frightful accident, and their replacement by your own, and the locomotives were destined to absolute failure; but the former seem to function satisfactorily, and the latter has a record as yet unequalled by any like piece of apparatus. True, you made no predictions of failure concerning that admirable part of the equipment which your company is to supply, although now so energetic in condemning its use elsewhere.

Your attack on me is misjudged, and is unworthy of your own dignity, for even if your personal qualities do not appeal to the softer side of my nature, and your assumptions do not always carry conviction, I still recognize in you many elements of greatness. It will therefore fail in its purpose, for it will not cost me a single friendship, and will not impair the confidence of my associates, nor do I believe it will adversely impress any fair-minded man though he be a stranger to me. I will go further—it will not affect my appreciation of the many splendid products, or affect my final judgment concerning any developments or proposals of the Westinghouse Company, which will live on even after your dominant personality in its affairs disappears.

Permit me in conclusion to remind you that my work and inventions have been among the stepping-stones to your great fortune, and while others, and not I, have reaped the larger material rewards of that pioneer work, I have at least succeeded in impressing my name upon the electric railway development in such indelible fashion that you cannot erase it. It has never stood for doubt, or cowardice, or fear of consequences, but always for advancement—in which in many important particulars you have followed, not led me.

My engineering convictions and conclusions are my own. They are dictated by no man or corporation. I am not the advocate of the use of any particular system to the exclusion of any other, but rather of higher potentials and the greatest measure of development by whatever means—for such system as in any particular case shall, when measured by all conditions of equipment and operation, best fulfill the requirements of that case.

That attitude is one which I shall consistently maintain, unchanged by clamor, pressure or disapproval, and so long as I am given life and strength, and retain the confidence of my associates, I shall help carry to success the enterprise which you have so freely criticised, and thus aid in planting another milestone to mark the advance of electrical accomplishment.

The following correspondence is appended by Mr. Sprague to his open letter to Mr. Westinghouse:

NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY,
GRAND CENTRAL STATION
NEW YORK, Jan. 2, 1906.

Mr. Frank J. Sprague, 20 Broad Street, New York City.

Dear Mr. Sprague:—Referring to recent discussions in the public press, in which your name has appeared in connection with decisions of our Electric Traction Commission:

It affords me pleasure to state that the relation that you hold to other interests has always been free and open to me, and that your attitude toward the different bidding companies has been entirely unbiased and impartial, as evidenced by your advocacy of what you have considered to be the apparatus best suited to our needs, no matter by whom manufactured.

Yours sincerely,
W. J. WILGUS, Vice-President.

NEW YORK CITY, Dec. 29, 1905.

General and Sprague Electric Companies.

Gentlemen:—I call your attention to a letter signed by George Westinghouse, which appears in the "Railroad Gazette" of Dec. 22, and is repeated in other journals, in which, referring to my critical attitude concerning the adoption of alternating-current locomotives by the New Haven Railroad under existing conditions, he makes the following statement:

"Mr. Sprague forgot to inform the public, probably as he would have done had he had more time, that he is receiving a very large retainer under a contract of years' duration, whereby, though he may become consulting engineer for a railroad, yet he cannot do so if, in the opinion of the officials of the General Electric Company, such work or obligation may be in conflict with the interests of that company."

My only contract with the General Electric Company is a brief one, simply guaranteeing the fulfillment of the Sprague's Company's obligations to me, and although my contract with the latter company—which bought my patents—is intended to prohibit my engaging in rival manufacture or consultation for a manufacturer engaged in a like business, I am not aware that, even if the General Electric Company has bought the Sprague Company, there is any reasonable ground for assuming that the officials of either company have the remotest right of interference with my legitimate work, for it is only proper for me to say that any such attitude would be distinctly opposed to my views.

I beg, therefore, to inquire if there is in your understanding of my contracts any justification for Mr. Westinghouse's inference, or anything which would in your opinion entitle you to such prohibition, or which would interfere in the remotest degree with such action on my part as may be dictated by the very highest interests of my clients.

An early reply will be appreciated.

Very truly yours,
FRANK J. SPRAGUE.

GENERAL ELECTRIC COMPANY
NEW YORK OFFICE, 44 Broad Street.
Jan. 2, 1906.

Mr. Frank J. Sprague, 20 Broad Street, New York.

Dear Sir:—Referring to your letter of Dec. 29, 1905, our policy is, as you know, to refrain from entering into a controversy in the newspapers over any particular system advocated either by our companies or by their competitors.

It is solely on account of your personal relations to the various traction interests of the country that we are writing this letter.

There is no reason, so far as the General Electric and Sprague Companies are concerned, why you should not act as consulting engineer for any steam railroad or for any power company, nor any reason why you should not give such companies for whom you act as consulting engineer such advice as seems to you proper, regardless of whose apparatus is to be used.

The General Electric Company and the Sprague Company are doing their utmost to develop the electrical art along all lines instead of wasting time in personal recriminations. These companies give the best engineering advice of which they are capable on the various propositions, which are from time to time submitted to them, and if, in any proposals which they may make for the equipment of steam roads, your judgment prompts you to decide in favor of a system which is recommended by their competitors, we feel sure that you will not hesitate for one moment to recommend such system.

The General Electric Company is in the business of manufacturing electrical apparatus, and is prepared to furnish alternating or direct-current systems as may be suitable. It has perfected what it believes to be the best alternating current railway system in the world, and wherever the circumstances make the use of such a system desirable, it recommends its adoption in preference to the direct system. The company does not, however, endeavor to force either system on the customer irrespective of the best engineering practice with reference to the special conditions under which the system is to be operated.

Very truly yours,
GENERAL ELECTRIC COMPANY,
E. W. RICE, Jr., Third Vice-President.
SPRAGUE ELECTRIC COMPANY,
Allan Bakewell, President.

ELECTRICAL EQUIPMENT FOR THE SIMPLON TUNNEL

In the issue of Dec. 9 it was stated that Ganz & Company had received a contract for the electrical equipment of the Simplon line, between Switzerland and Italy. Later information from Ganz & Company, as well as by Brown, Boveri & Company, indicates that this statement is not strictly correct. As a matter of fact, the electrification of this line has been entrusted by the Swiss Government to the Swiss firm of Brown, Boveri & Company, who are already well known for their three-phase traction work in connection with other Swiss railways. On the other hand, inasmuch as the Simplon line reaches into Italy, and will eventually be operated jointly by the Swiss State Railways, and by the Italian Government, the latter has arranged with Ganz & Company for the use of some of the three-phase locomotives now employed on the well-known Valtellina line for the Simplon tunnel, and has placed these locomotives at the disposal of the Swiss Government, so that the tunnel may be opened for public traffic in June, 1906. Brown, Boveri & Company are now building two further three-phase 1000-hp electric locomotives, which will also be used to handle the traffic through the Simplon tunnel.

COMPLETION OF IMPORTANT LINK CONNECTING THE INTERURBAN LINES OF OHIO, INDIANA AND MICHIGAN

One of the most interesting events in the history of electric railway building in the Central West took place at Findlay, Ohio, last Saturday, when a golden spike, presented by the STREET RAILWAY JOURNAL, was driven by President A. E. Akins, of the Western Ohio Railway, in the last rail of that company's Findlay-Lima extension.

MAP SHOWING THE PRINCIPAL INTERURBAN ELECTRIC RAILWAY SYSTEMS IN OHIO, INDIANA, MICHIGAN AND WESTERN PENNSYLVANIA. THE CONNECTING LINK, WHICH WAS COMPLETED ON DEC. 30, IS INDICATED BY THE HEAVY DOTTED LINE BETWEEN FINDLAY AND LIMA. THE LIGHT DOTTED LINES SHOW PROPOSED LINES OR THOSE UNDER CONSTRUCTION

The importance of this connecting link is graphically shown in the accompanying map, in which the link is indicated by a heavy dotted line. It will be seen that with this connection it is now possible to travel continuously on electric lines throughout Northern Pennsylvania, Ohio, Michigan and Indiana. The building of electric lines in these States has been somewhat peculiar, from the fact that the lines have been in groups, leaving a strip extending clear across the northern portion of Pennsylvania, Ohio and Indiana which had never been crossed. For some time it has been possible to travel from Northern Pennsylvania points across Northern Ohio into Central Michigan, or from points in Eastern Ohio to points in Western and Northern Indiana, but the lines in Michigan and Northern Ohio have had no physical connection with those of Central and Southern Ohio and Indiana. It is also interesting to note that geographically this 32 miles extension is almost exactly in the center of the traction development of the Central West. The completion of this line renders possible a journey from Titusville, Pa., to Crawfordsville, Ind., a distance of about 615 miles, by electric lines. The importance of the event is still more obvious when it is stated that the connected properties include forty-eight roads in Ohio, with a mileage of 2261; eight systems in Michigan, with

a mileage of 482; three roads in Pennsylvania, with a mileage of 75, and eleven roads in Indiana, with a mileage of 888. This makes a total of seventy individual properties, with a mileage of 3706, not taking into account over a thousand miles of city lines. If stretched out in a continuous line this would extend from New York to San Francisco, with 300 miles for double tracking, or it would extend from New York to London.

To the electric railways of this district this event is almost as important as was the completion of the Union Pacific Railroad to the steam lines forty years ago, and the management of the Western Ohio Railway Company proposed that it be appropriately celebrated with a ceremony similar to that which attended the completion of the first trans-continental steam road.

The ceremony was accomplished after many annoying vicissitudes. General Manager F. D. Carpenter, of the Western Ohio, invited traction men from all over the three States, and special cars were arranged for from Indianapolis, Fort Wayne, Dayton and Cleveland. The plan was to run the cars through to Findlay, where the ceremony was to take place, and to drive the spike between the cars from these distant points, and then for the entire party to run over the new line to Lima for a banquet. On the morning of Dec. 31, the day selected for the ceremony, it was found impossible to carry out this plan, owing to the fact that a short piece of city track in Lima, the property of the Lima Electric Railway & Light Company, had just been relaid on concrete, and it was considered by the management of that company inadvisable to allow cars to operate over it. The Fort Wayne and Indianapolis aggregations were, therefore, turned back by telephone, while the two carloads of guests from Dayton, who had already arrived in Lima, were conveyed in carriages around the quarter mile of embargoed track to two special cars from Findlay, which were sent over after it was found that the other cars could not get through. The ceremony was to have taken place at Findlay at 2 p. m., but the first car from the southern contingent did not arrive until 5 p. m. The second car from the south was still further delayed, and did not arrive until after the ceremony and an impromptu banquet provided at Findlay were over, and the Cleveland contingent had started for home. The second Dayton delegation came into the hotel at Findlay singing the appropriate song, "Hail, Hail, All the Gang is Here Now." Hungry and tired they carried out a celebration of their own which lasted until late in the evening.

The driving of the golden spike was effected by the aid of the moonlight. President Aikins made a few appropriate remarks, and read the inscription on the spike as follows: "Last spike in the link connecting Pennsylvania, Ohio, Michigan and Indiana electric railways. Driven at Findlay, Ohio, Dec. 30, 1905. Western Ohio Railway. Presented by the STREET RAILWAY JOURNAL." Then, with a few taps, the spike was driven home. Afterwards it was extracted and replaced by another of less brilliant color.

During the supper which followed, addresses were made by E. C. Spring, president Ohio Interurban Railway Association; A. E. Aikins, president Western Ohio Railway; F. T. Pomeroy, president Cleveland & Southwestern Railway; H. W. Blake, editor STREET RAILWAY JOURNAL; the Mayors of Findlay and Lima, and several other gentlemen.

The Cleveland contingent included F. T. Pomeroy, president; E. F. Sneider, secretary; C. N. Wilcoxson, general superintendent; J. A. Nestor, superintendent; J. O. Wilson, passenger agent; L. M. Coe, M. A. Sprague, W. D. Thompson, directors of the Cleveland & Southwestern; W. M. Bicknell, president Lake Shore Electric Railway; Will Christy, vice-president Northern Ohio Traction & Light Company; A. E. Aikins, president Western Ohio Railway; C. R. Morley, president Stark Electric Railway; J. F. Collins, Toledo Railways & Light Company; W. E. Davis, Cleveland Construction Company; W. H. Abbott, Roberts & Abbott; H. W. Blake and George S. Davis, STREET RAILWAY JOURNAL. The car left Cleveland at 6:10 a. m., and made a fast run of 4 hours 10 minutes to Toledo, over the Cleveland & Southwestern to Norwalk and the Lake Shore Electric to Toledo. From Toledo the car proceeded south over the Toledo & Maumee Valley Railway and the Toledo, Bowling Green & Southern route. Returning, the Cleveland car left Findlay at 6 p. m. The trip was made in one of the magnificent new cars of the Cleveland & Southwestern, which were illustrated in a recent issue.

SPECIAL CAR AND PARTY FROM CLEVELAND WHO ATTENDED THE CEREMONY OF OPENING THE NEW ELECTRIC LINE FROM FINDLAY TO LIMA

The first special from Dayton traveled over the Dayton, Covington & Piqua and Western Ohio lines, making an excellent run. In this party were E. C. Spring, superintendent, and R. D. Coburn, master mechanic, Dayton, Covington & Piqua; J. R. Harrigan, general manager, Columbus, Newark & Zanesville; Theodore Stebbins, general manager Appleyard lines; F. D. Carpenter, general manager, and J. H. Merrill, auditor Western Ohio; H. F. Dicke, superintendent Fort Wayne, Van Wert & Lima, and a number of others. The second party included H. P. Clegg, president; C. M. Paxton, traffic manager; R. A. Crume, auditor; W. E. Rolston, general superintendent; A. J. Ward, advertising manager of the Dayton & Troy; R. H. Carpenter, general passenger agent; J. Wilcoxson, superintendent; Charles Price, publicity man of the Western Ohio; F. J. Green, general manager, and J. W. Parker, superintendent Springfield, Troy & Piqua, and F. A. Ferneding, superintendent Dayton & Xenia. They made the trip over the Dayton & Troy routes.

J. Kilgore, vice-president, and W. L. Smith, general manager of the Toledo, Bowling Green & Southern, assisted greatly in the success of the affair, by taking care of arrangements at the Findlay end, and providing special cars for the parties from the south. During the afternoon the Cleveland party visited the new power station of the Toledo, Bowling Green & Southern, which is one of the finest in the State, and which was described in a recent issue of this paper.

In the very near future the Dayton & Troy, Western Ohio and Toledo, Bowling Green & Southern lines will commence operating limited service between Dayton and Toledo, 162 miles, this being made possible by the completion of the new line.

DECEMBER MEETING OF THE OHIO INTERURBAN RAILWAY ASSOCIATION

Interest in the Ohio Interurban Railway Association is increasing, and the attendance at the meeting held at the Chittenden Hotel, Columbus, Dec. 28, was the best which has ever occurred outside the annual meetings, when there are banquets.

J. C. Reese, of the Steubenville Traction & Light Company; E. J. Davis, of the Columbus, Buckeye Lake & Newark Traction Company; George Whysall, of the Columbus, Delaware & Marion Railway, and A. W. Jordan, of the Columbus, London & Springfield Railway, were admitted to membership.

President Spring reported on the plans for the annual meeting and banquet, to be held at Dayton, Jan. 25. A number of very prominent traction men have been invited and have promised to attend, and will probably make addresses. These gentlemen include H. H. Vreeland, president of the New York City Railway Company, of New York; T. E. Mitten, president of the Chicago City Railway, and W. Caryl Ely, president of the American Street & Interurban Railway Association. The Governors of Ohio and Indiana and prominent State and local officials have also been invited. The attendance will of necessity be limited to 200, and it is expected that fully that number will be present. Tickets to members this year will be $2.50 a plate, and it has been decided that the association shall take care of the entire entertainment without the financial assistance of the supply men.

Mr. Spring also reported that the committee from the Ohio Association which recently made overtures to the members of the Indiana State Association for a consolidation of the two organizations, had met with much encouragement and that the Indiana Association had appointed a committee of five to confer with a similar committee from Ohio. The latter committee, composed of E. C. Spring, Theodore Stebbins, H. P. Clegg, F. D. Carpenter and J. O. Wilson, will confer with the Indiana committee some time within the next two weeks, with power to act. In the event of the consummation of the plan, the annual meeting and banquet will be the first meeting of the merged association, which will probably be known as the Interstate Interurban Railway Association, and new officers will be elected at that time.

The nominating committee of the association adopted an alternative slate, which will be presented in the event that the two organizations do not get together. If, however, the merger plans are successful, the new list will include representatives from both States. The executive committee will probably be composed of ten men, five from each State, while it is probable that Ohio will have the selection of the president and secretary and Indiana the vice-president and treasurer. President E. C. Spring has been urged to accept the chief executive office of the new association if it is effected. It is felt that it is due to him on account of his strenuous work in the formation and accomplishments of the Ohio Association, and on account of his apparently successful labors in bringing about a consolidation.

Mr. Spring pointed out that in the event of the consolidation, the necessity for a permanent secretary would be more urgent than ever. He stated that sixteen Ohio companies had agreed to contribute $50 each toward the support of a permanent office, and at least ten more could be secured. He felt, therefore, that the success of the plan was assured whether the consolidation was effected or not, but in event that it is, the contributions of a dozen or more Indiana roads would add greatly to the efficiency of the office. A decision on this matter will be left until after the annual meeting.

INTERCHANGE OF CARS

Theodore Stebbins, of the Appleyard lines, asked that the subject of a uniform charge for foreign cars while on other roads be reopened and thoroughly threshed out. This has been discussed at several previous meetings but nothing accomplished. He said that the mechanical side of the controversy had been entirely ignored. Steps should be taken to compile information as to dimensions and sizes of cars and maximum clearances on all lines, so that it would be known in advance whether it was possible to run a car over another road and what the conditions were. He said also that the legal side of the question should be looked into. His attorneys had advised against allowing other cars on his lines, except under certain conditions to which some roads were unwilling to accede. He has frequent demands for such interline business, and thought it imperative that a standard form of contract should be adopted.

C. F. Wilcoxson, of the Cleveland & Southwestern, thought this was a matter which should be taken up by a permanent secretary, who would have time to compile full information covering all dimensions of cars and clearance on all connecting lines and have this tabulated and sent out. He thought the interurbans should take concerted action to secure wider devil strips in cities, because in many places it is impossible for cars of even a reasonable width to pass.

It was decided to table this subject for a later meeting.

A. W. Anderson, of the Dayton & Xenia Traction Company, was appointed treasurer to fill the unexpired term of R. E. DeWeese, of the Dayton & Northern Traction Company, who is ill and incapacitated for work.

ADVERTISING

The subject of the "Best Methods of Advertising" was discussed.

A. L. Neereamer, of the Columbus, Delaware & Marion, who introduced the subject, said that interurban roads could not do too much advertising, providing it was done in a judicious manner. He thought that many steam roads had gone to the extreme and were wasting money. Above all, he favored newspaper advertising, but he preferred to pay for short reading notices rather than display advertisements. Special advertising in college publications and programmes, according to Mr. Neercamer, was money wasted in the majority of cases, as many of them are simply fly-by-night schemes with no circulation or reliability. If special advertising was done, it should not be cheap. Calendars at the first of the year are good, providing they are attractive and legible. The average business man throws away all but one or two of the best. Hand bills and circulars distributed from door to door are not much account. In towns where there are no daily papers, he favored cards placed in windows; also cards on posts at country stopping points. He favored bill-board advertising for summer resorts where the business justified it. Locations for boards should be carefully selected and specified by the railroad company. Bill-posters have a trick of using isolated places for their long-time customers and keeping the good ones for transients. He thought it well to have a man inspect bill-boards occasionally to see that agreements were carried out. He thought souvenir buttons an excellent plan of advertising. A year ago his company put out a large quantity showing a car and the name of the line and points reached, and he said these were still being worn by many children. At this point Mr. were still being worn by many children.

F. J. Sloat, of the Cincinnati Northern Traction Company, spoke of a very attractive poster that had been published by the Detroit, Monroe & Toledo Short Line. He thought posters were an excellent method of advertising, and said that they should show plainly the route of the road but should not contain more printed matter than actually needed.

F. D. Carpenter, of the Western Ohio, said that local people

on the majority of lines had learned the local points, but comparatively few people realized the great development of interline business and the long distances that could be covered at low cost. He thought all the individual roads should advertise the connections in every possible way, and that the association as a whole should take action to publish suitable guides and time tables. This was another subject to which the permanent secretary should devote considerable attention.

Theodore Stebbins argued against the tendency to cut rates in order to get long-distance business, and he especially deplored the tendency to make low rates and run special cars for such excursions.

F. W. Adams, of the Toledo, Fostoria & Findlay Railway, said that forty was the minimum number for which his company would run a special car, and then only a slight reduction was given. He did not see the necessity for the low excursion rates which have been advertised recently by some of the roads.

George Whysall, of the Columbus, Delaware & Marion Railway, thought there was not a sufficient interchange of advertising material among the various roads. He thought the steam practice of having time tables of uniform size and uniform racks in all stations should be followed. Few electric lines have such racks, and although the agents may have time tables of other roads, they are usually kept back of the desks and only given out when asked for.

J. O. Wilson, of the Cleveland & Southwestern, said they had issued time tables of steam road size and had distributed them liberally in all cars and stations. This was the best advertising with which he was acquainted. On the subject of reducing rates for special events, he thought it necessary at times to meet the rates made by steam roads, but frequently the latter make rates which it is folly to meet. Recently a college at Oberlin played a football game at Cleveland, and the competing steam road offered a special train with a rate of 75 cents for the round trip of 35 miles. He met this rate, and by the liberal use of cards and posters secured the business, his road hauling 326 people while the steam road had only twenty-four. On another occasion the steam road offered a special car with a baggage car for baggage at $24. He could not see any profit in it at that price and did not make any attempt to secure the business.

A. L. Neereamer, of the Columbus, Delaware & Marion, told of a similar experience. The steam road made a haul of 38 miles and sold a ticket which contained coupons for city car fare and admission to a park; it netted the steam road 23 cents round trip. He said: "I would not attempt to meet such a rate; but when you can meet their rate, advertise it well and you will get the business."

C. M. Paxton, of the Dayton & Troy Railway, said that in conjunction with the Western Ohio that company employs a publicity man who confines his efforts to reading matter and advertisements to the daily and weekly papers along the line. They are treated very liberally by papers in the matter of reading notices, display advertisements and time cards. Nearly every issue of these papers contains a display advertisement in addition to the time table, the advertisement usually filling 5 ins. or 6 ins. and more for special events. These are paid for entirely with transportation and by carrying papers free of charge. By this means the Dayton papers have been enabled to get their papers in all towns throughout a wide district earlier than the papers of other large cities, and their circulation has increased largely. They have not been imposed upon with requests for transportation. It is possible, however, that next year the papers may decide to pay for their advertising in cash and charge for transportation and papers. In any event, the company will continue to advertise liberally in all papers along its line.

F. W. Coen, of the Lake Shore Electric Railway, thought that clean, comfortable cars, fast service and keeping cars on time was the best possible means of advertising. In small towns he did not consider it necessary to advertise freely, so long as there was plenty of literature in the stations, but in the larger cities he favored advertising. In all cities and towns except Cleveland his company pays for time cards in papers with transportation. This is usually in the form of trip passes, which are taken up if presented by improper persons, but they are seldom misused. Mr. Coen believed in supplying news matter to newspapers and, wherever possible, photographs of interesting views and events.

E. C. Spring, of the Dayton, Covington & Piqua Traction Company, thought that in all advertising consideration should be made of the fact that the interurbans derived their chief revenue from the poorer and less intelligent classes. Advertisements should be made simple and legible. Stations should be designated by ample signs, and should be well lighted so that they can be found at night. There should be a large bulletin board in each waiting room containing notices of special events, also racks for time tables. He thought a calendar was an excellent advertisement, but said that it must be legible and, above all, attractive. He brought down the house and threw the young lady stenographer temporarily out of business by displaying a high-art production recently circulated by his company with the remark, "Could any man throw that away."

SHOP RECORDS

The subject "Shop Records" was introduced by J. C. Gillette, of the Columbus, Delaware & Marion Railway. He asked for expressions of opinion as to whether it was desirable to keep an accurate account of mileages on all parts and work on separate jobs, for an interurban road of, say, 50 miles. His company has no storekeeper, and in order to keep such a record it would be necessary to have a man who could devote his time to the work. The foremen of departments make daily reports of all material used, but they have no detailed reports or job cards. They have a daily car report, 3 ins. x 5 ins., which contains a statement of the condition of the car. This is made in duplicate and is signed by the motorman and conductor. One copy remains in the car for the car-house foreman and the other goes to the office. The foreman makes a note on this card of all light repairs, such as motor work, brake-shoe work, etc., and files the card in a card system. Then they have another 3-in. x 5-in. card, on which are reported all general overhauling, wheel and armature work, etc. One copy of this card goes to the main office and the other to the master mechanic. Mileages are taken from the train sheet and filed in a card system daily for each car. Mileages of car bodies and trucks are kept separately, as the company frequently shifts trucks. The company keeps mileages on certain wheels and brake-shoes. A record is also kept of oil, grease, waste, etc. This is footed each month and reduced to a 1000-mile basis from the mileage sheets. Mr. Gillette remarked that it was surprising what a variation there was in the life of brake-shoes; some shoes of the same makes and quality being as low as 50 cents per 1000 miles and others as high as $1 per 1000 miles.

A. M. Frazee, of the Columbus, Buckeye Lake & Newark Traction Company, said that they kept the standard Accountants' Association system of accounting. Each special job is kept on a card and charged against each car on a card index. The company has charge slips showing the cost of wheels, armatures, axles, journals, trolley wheels, car cleaning, etc., and reports are made on each monthly on a basis of 1000 miles. Gears and wheels are numbered and are charged to certain cars and checked off when they are replaced, so that an accurate record is kept of their life. His experience with brake shoes was the same as that of Mr. Gillette, except that the maximum was sometimes as high at $1.20 per 1000 miles.

L. C. Bradley, of the Scioto Valley Railway, said that from

the first they had kept an accurate record of costs. In all they have twenty-five accounts in the material and shop department, which is considerably more than used by the Accountants' Association. In all cases of repairs or replacements, the electrical and mechanical work are separated. They have a casualty account, to which is charged labor and material for all work resulting from accidents while on the road, and such items are not charged to maintenance. He thought this plan more equitable to the master mechanic than charging all accidents to maintenance, as it did not necessitate explanations when the maintenance was unusually high. They do not keep an individual car expense account, and did not think it of sufficient importance to warrant the extra expense.

J. R. Harrigan, of the Columbus, Buckeye Lake & Newark Traction Company, asked Mr. Bradley how it was possible for him to determine the life of wheels and brake-shoes.

Mr. Bradley said that they made periodical tests of all such equipment, and in trying out new material or new lots of material they kept an accurate mileage. He thought that it was not always the part that gave the greatest mileage that was the most economical. They tested material with a view of ascertaining the effects on other material, the scrap value, etc. In general, they reduce quantities of material to the 1000-mile basis, but do not attempt to keep the actual mileage of each article that is used.

Form 77. 2 m. 9-05.

The Lake Shore Electric Ry. Co.

CAR MILEAGE RECORD.

190

1	64
2	65
3	66
4	67
5	68
6	69
7	70
8	71
9	72
10	100
11	101
12	102
14	103
15	104
16	105
17	106
19	107
20	113
21	114
22	115
23	120
24	200
41	201
42	202
43	203
44	204
50	205
51	5002
52	5003
53	5004
54	5005
55	5006
56	5008
57	5009
58	31
59	32
60	33
61	39
62	K
63	J

AUDITOR.

(Front of Tag)

SHOP

Repairs made .....

Date ..... Repaired by .....

(Back of Tag)

Inspector's Tag ..... LINE .....

Car No. ..... Truck No. .....

Trouble .....

Time ..... Date .....

MILEAGE RECORD AND TAG USED BY LAKE SHORE ELECTRIC FOR KEEPING RECORDS OF MILEAGE AND REPAIRS

C. F. Wilcoxson, of the Cleveland & Southwestern, said he failed to see the distinction between expenses caused by natural wear and those caused by accidents. Other than so far as to report to the management the extent and causes of accidents, he saw no advantage in separating the accounts. The majority of minor accidents were due to the carelessness of trainmen, and he thought that repairs for such accidents were clearly an item of maintenance. However, the plan was interesting as showing what per cent of maintenance actually came from natural wear under normal conditions. He thought that small roads could not afford to keep accurate data of the life of all parts. Frequently items of expense were so small that they made no perceptible difference when reduced to the 1000-mile basis. He uses a card system for car reports and keeps an accurate record of all wheels and armature bearings, but not of smaller items. On trolley wheels and harps they make frequent tests and attach a card to the pole. This shows the life of the harp and bushing as well as the wheel. They have periodical tests on life of bearings, armatures, wheels, etc.; on wheels the value is determined by the cost of 1-16-in. turning per wheel.

F. W. Coen said the Lake Shore Electric uses a card system. Cars are inspected regularly and the inspector attaches to the car a small tag containing space for the inspector's number, line, car number, truck number, description of trouble, time and date. On the reverse side of the tag is the name of the shop, description of repairs made, date and signature of man in charge of the job. The train despatcher makes a daily report of the mileage of each car, and this, together with the card mentioned, is filed under each car number. (This tag and mileage record are reproduced herewith.)

Mr. Frazee said that they charged casualties to maintenance, but made a special report to the office and the office keeps an account of the nature and cost of damages. They have an inspector who gives a daily inspection to all cars and makes a report of all requirements, his card list showing the conditions of all parts of the car daily. Work in the shop is divided between four men or four classes of men, each man taking care of a certain class of work and being responsible for that only. Material for these classes of repairs are charged to the individual who takes care of the particular class of work. The car record must be checked off by each man, and no car is allowed to go out on the road unless in perfect operating condition. Where there is trouble or an oversight, the neglect can be charged directly to the individual.

Mr. Gillette said that in their shop, work was given out to men in pairs who worked together and performed all the necessary work, except that car cleaning, trolley oiling and stove replenishing were designated to a special man.

TRANSPORTATION OF EMPLOYEES

The subject "Transportation of Employees and Dependents" was particularly pertinent at this time, when a number of the steam roads are greatly reducing the number of passes to employees. One of the largest electric systems in this State has recently adopted the same policy, and the manager who defended this position was strongly criticised by the majority of managers. The gentleman in question took the position that an electric road was no more under obligations to furnish employees and dependents with free transportation for pleasure purposes than was a grocer obligated to furnish free supplies to his employees. The general sentiment was that this was not a parallel case.

Theodore Stebbins, of the Appleyard lines, said that when he first took charge of the properties, there was practically an unlimited supply of passes for all employees and no records were kept. He instituted a number of restrictions and records which are valuable and interesting. He operates six different roads and has about 400 employees. At present they use 15,000 to 18,000 passes per month and travel 110,000 to 125,000 miles per month. This he thought too much. He has recently adopted the form of employees pass which is illustrated herewith. It shows the points from and to, and has space for the signature of the employee, train number and conductor's number, and it is punched between certain points. In some cases a man is permitted to ride over any of the roads, while in others the points are designated by punch marks before they are given out. Records are kept of when issued, when used and distance traveled, and these are in tabulated form, so that it is possible to determine whether a man travels more than is necessary. This gives a good check on how roadmen, particularly inspectors, are attending to their duties. Superintendents inspect the signatures frequently to determine that the passes are not abused. Comparatively few passes are issued to families of employees; requests do not average more

than one a day for the entire system, and these are seldom refused. The transportation of section men is quite a problem. Formerly one road 50 miles long had three sections. This has been increased to five and the men provided with hand-cars, which eliminates passes and keeps the men out of the cars. Where section men are moved from one point to another, the superintendent supplies them with two pass slips each night. The pass slips cost 35 cents per 1000, and are cheaper and more convenient than card passes in combination with "dead head" slips.

Mr. Sloat, of the Cincinnati Northern, said they had recently adopted a form of mileage similar to the standard coupon book which is issued for advertising and to certain employees. Strips are pulled out to cover the regular fare. He is endeavoring to find a flexible form of transportation to take care of track and trainmen, but finds it difficult.

F. W. Coen said that the Lake Shore Electric Railway issued no card passes of any kind. Annual passes for employees are put up in books of fifty coupons. One side contains the restrictions and number, and the reverse side contains the stations from and to. Conductors must have something to show for every passenger. The cover contains a contract and release clause and the signature of the holder; no "dead head" slips are used. Books are not good on limited trains, but in certain cases a card authorizing the conductor to accept them on such trains is issued. A record is kept of the books, and if abused they are called in. The company is very liberal with dependents of employees. Trip passes are issued by the superintendent or division superintendents and department foremen practically whenever asked for. The company feels that the men spend the best part of their lives in their work, and that they are entitled to every reasonable consideration. One of the division headquarters is in an isolated town where no supplies can be purchased, and it would be a great hardship for the families to be obliged to pay for transportation.

C. F. Wilcoxson shared this opinion. He thought that if men were refused transportation they would beat their way, and the temptation to break rules covering this point would lead to infractions of other rules. Trainmen, shopmen, etc., have issued to them monthly books with a sufficient number of coupons for actual working days. Stations are printed on them, and in case of some men they are punched in advance; others may travel anywhere on the road. Coupons must be signed on the back. Passes for wives of employees only are issued by the superintendents, and the dependents of single men are not refused.

E. C. Spring said he believed in liberality to families of employees. He referred to one particular case where a wife of a motorman and a sick child had been carried to and from Dayton every day for several weeks.

A. W. Anderson said they frequently asked men to perform extra and hazardous duties for which they gave no extra compensation, and the least they could do was to be liberal in transportation, which actually cost the company nothing, as the cars ran anyway. They issue passes to all dependents of employees, and much prefer that a man ask for a pass than have his wife "dead headed" by some other employee. Employees' passes are contained in books issued monthly. These passes are signed on their face and the points are indicated by punch marks.

Mr. Whysall said he believed in liberality, but his company declined to issue trip passes on Sundays and holidays, when the loads were heavy. Passes for the majority of employees are good only between certain points.

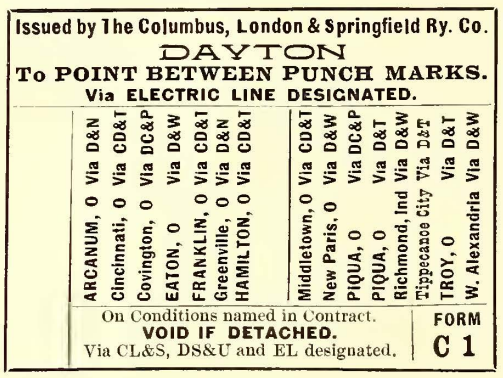
Mr. Adams told a story of an Irish brakeman, who asked his superintendent for a pass to go home on Sunday. The latter said, "If I were a farmer and you my hired man, would you expect me to hitch up and take you to town?" "No," said Pat, "but if you were hitched up and going to town, I'd think you a d—— mean man if you wouldn't give me a ride." Mr. Adams said that was his position exactly.

THREE FORMS OF EMPLOYEES' FREE-TRIP TICKETS GIVEN BY OHIO INTERURBAN ELECTRIC RAILWAYS

INTERLINE TICKET

Mr. Sloat, chairman of the committee on a new form of interline ticket, presented a form of multiple-destination ticket which he believed overcame the objections offered at the Youngstown meeting, and which were outlined in the issue of the STREET RAILWAY JOURNAL for Dec. 9, 1905. As stated then, it was considered desirable to have a form of interline ticket which would show the point of sale and destination on each coupon, so that each road would have this information without waiting for a monthly report from the selling road. The ticket contains the contract on the upper end, and at one side the year, month and day to be punched for time limit. The contract is the same as that used in the skeleton form of interline ticket which was illustrated on page 92 of the STREET RAILWAY JOURNAL for Jan. 14, 1905, except that a sixth clause is added which provides that where used on limited cars, an excess fare may be collected according to the rules of the company collecting the coupon. Attached to the main part of the ticket are the several coupons. One of these coupons, collected by the final company, is illustrated on page 36 to give an idea of the character of the form used. This coupon contains

the principal stations on several routes radiating from a large terminal city; also the route. Where the ticket is for a station not designated, the agent fills in the blank space in the center. All tickets have at the bottom an agent's stub, which is of the same size as the other coupons and contains space indicating the amount paid by the passenger. This space is filled in by the agent when the ticket is sold. There are two, three or four intervening coupons for various routes over which a ticket is likely to be sold and each coupon has the name of the collecting road printed on it, with the terminal city of that road. Each coupon also bears the list of the selective routes and towns for the final destination. In selling the ticket the agent folds the ticket between each coupon so that the station lines register under each other and punches the desired destination and route. The ticket is good from the point stamped on the back to the destination indicated, and, as stated, each coupon shows these points. Half-fare tickets will probably be indi-


Issued by The Columbus, London & Springfield Ry. Co.

DAYTON

To POINT BETWEEN PUNCH MARKS.

Via ELECTRIC LINE DESIGNATED.

ARCANUM, O	Via D&N	Cincinnati, O	Via CD&T	Covington, O	Via DC&P	EATON, O	Via D&W	FRANKLIN, O	Via CD&T	Greenville, O	Via D&N	HAMILTON, O	Via CD&T	Middletown, O	Via CD&T	New Paris, O	Via D&W	PIQUA, O	Via DC&P	PIQUA, O	Via D&T	Richmond, Ind	Via D&W	Tippecanoe City	Via D&T	TROY, O	Via D&T	W. Alexandria	Via D&W

On Conditions named in Contract.
VOID IF DETACHED.
Via CL&S, DS&U and EL designated.

FORM C 1

SAMPLE COUPON OF SELECTIVE INTERLINE TICKET. THIS COUPON IS TO BE COLLECTED BY FOREIGN ROAD

cated by a suitable punch mark so as to eliminate separate colored tickets. Round-trip tickets will be of the same general character, except that they will have double the number of intervening coupons and will be white, while the single trip will be green. Water-marked safety paper will be used. It is not intended that this new coupon ticket shall entirely supersede the skeleton form of ticket adopted some time ago and now in general use, but the new form will be used by those that desire it, and its chief advantage lies in the fact that it can be issued more quickly than the other ticket. On the other hand, it is not as practical for long routes over more than three or four roads on account of the inability to print a large number of routes and towns in a small space.

On vote, the ticket was authorized, and Mr. Sloat was instructed to make a few minor changes that were suggested.

A NEW METHOD OF REBATING

The Illinois Valley Railway Company is issuing a coupon commutation rebate book, having a sliding scale of rebates somewhat out of the ordinary. The book, which contains 100 coupons, each having a face value of 5 cents, sells for $5, or at the face value of the coupons. If used within thirty days from date of sale a rebate of $2 is made upon the surrender of the cover. If the cover is returned within sixty days, the rebate is $1, while a rebate of 50 cents is made if it is returned within ninety days. This method of rebating avoids the use of several books of different values, yet gives to those using the road extensively a cheaper rate than the casual traveler.

The Toledo, Port Clinton & Lakeside Railway is about to inaugurate limited service between Toledo and Marblehead. The distance is about 50 miles, and the time will be 1 hour 45 minutes, of which 23 minutes are required in getting out of Toledo. There will be three limited cars each way daily.

NEW YORK STATE JANUARY MEETING

As stated in the last issue of the Street Railway Journal, the first quarterly meeting of the Street Railway Association of the State of New York has been called to convene in Schenectady, N. Y., on Jan. 10, for the discussion of mechanical subjects. President Danforth states that the replies received in response to the official notice forecast the complete success of the meeting. The attendance of mechanical men from New York State and the adjoining territory promises to be large and representative, and the interest manifested indicates good results from the conference. As stated in the circular, the meeting will be called at 9:30 Wednesday morning, Jan. 10, in the rooms of the Schenectady Railway Benefit Association, at the Fuller Street station, Schenectady, N. Y. It will be continued throughout the entire day and will be devoted to a discussion of topics included under Accounts 6, 7, 8 and 9, namely, maintenance of cars and equipment. Short papers will be presented on "Cleaning and Handling Cars in Car Houses"; "Lay-Over Inspection vs. Night Inspection," and "Car Maintenance," and opportunity will be given for asking and answering questions relating to any of the topics covered by the mechanical department. There will be no entertainments, no exhibits, no supply men, and absolutely nothing to detract from the serious work of the conference. A light buffet luncheon will be served in the middle of the day at the expense of the association. Representatives of mechanical departments and also of operating departments, both in New York State and outside of the State, whether members or not, are cordially invited to attend this conference and take part in the discussions.

FIRST ANNUAL MEETING OF THE PORTLAND (ORE.) RAILROAD COMPANY'S RELIEF ASSOCIATION

The first annual meeting of the relief association of the Portland Railroad Company, of Portland, Ore., was held recently at the St. John car house, with a large attendance representing nearly all the divisions of the company. The annual reports were presented, showing the association to be in excellent financial condition. President Jesse C. Estes in his report gave the following facts: The total membership is 102, four having dropped out by reason of leaving the employment of the company. Nine claims for sickness and disability have been paid amounting to $132.84, one claim being for the full amount of $60. The amount of $168.84 is on deposit in the Casco Bank. George A. Milliken, the treasurer, reported as follows: Receipts for the year, $399; payments for the year, $230.16; balance on hand, $168.84. The following directors were elected to serve for the next year: J. C. Estes, E. H. Belyea, C. M. Durell, W. A. Worthing, J. Frank Babbidge, N. P. Grant, Charles D. Bayd, F. G. Carey, F. H. Knight, George A. Milliken, Merrill E. Crossman, F. R. Larrabee.

Shaft bearing practice is tending toward higher temperatures, according to A. M. Mattice, who stated in the topical discussion upon bearings at the recent New York meeting of the American Society of Mechanical Engineers, that in his examinations of large numbers of engines in service, he has found more bearings hotter than 135 degs. F. than cooler. In many cases, temperatures as high as 150 degs. F. are operated under constantly without trouble, while one instance of an operating temperature of 180 degs. F. was cited. Where engines are direct connected to generators, the bearings are subject to much greater rises of temperature than in other classes of machinery, as the proximity of the heated generator and other parts prevent the ventilation that is necessary for proper cooling.

CORRESPONDENCE

THE LOCATION OF TOILET AND SMOKING ROOMS

San Jose, Cal., Dec. 18, 1905.

EDITORS STREET RAILWAY JOURNAL:

I have noticed the suggestions being made in your paper as to the proper locations of toilet and smoking compartments on interurban cars. I have had considerable experience in the practical operation of interurban cars, and am very much in favor of the single-ended car, as a large controller and other appliances on the rear platform take up considerable room that might be otherwise utilized for passengers when the cars are crowded. For a single-ended car I believe that the smoking compartment should be placed in the forward end of the car, with its entrance from the front platform in the right-hand corner of the platform. The motorman's cab should be triangular in shape and in the opposite corner of the front end of the car. The door by which it is entered would normally be kept closed.

Now, as to the toilet, I suggest that it be placed at the rear of the car on the left-hand side, and that the heater be placed directly ahead of it; this would make a very compact arrangement. I would also advocate cross-seats throughout the car.

WILLIAM COULTER.

OIL FOR MOTOR LUBRICATION

GALENA-SIGNAL OIL COMPANY

Franklin, Pa., Dec. 21, 1905.

EDITORS STREET RAILWAY JOURNAL:

Having read the discussion in your journal on "Oil vs. Grease for Motor Lubrication," I desire to make a few statements in regard to some of the difficulties existing and to be overcome in the introduction of oil lubrication, in order to get the best results.

Much has been said in regard to methods of application and various types of cups for feeding the oil to the motor bearing. Admitting that a good quality of oil is the first essential, and that a good cup is an indispensable device in oil lubrication of motors with bearings designed for grease, it is nevertheless a fact that in many instances one of the most important factors is overlooked, namely, that of familiarizing the inspectors and oilers with the necessary difference in the care and attention required in the use of the two lubricants. It can truthfully be said that many failures with oil lubrication or inability to get as good results as are known to have been secured elsewhere can be accounted for in the lack of interest taken by those making the trial test. To do anything correctly or successfully means that the work to be done must have the attention of an interested person. Then when a change from grease to oil is contemplated, the oilers or other car house men directly in touch with the work of equipping the motors must at least have that interest necessary to an impartial trial. If the above rule is not followed, the master mechanic will often find that the "object" he sought to obtain has been defeated in advance. I mean by this that when a good method of oil lubrication has been adopted there is less work in caring for the electric equipment in every way than when grease was used, but to convince the pitmen of this fact is often a difficult task, as to them any change ordinarily suggested in shop practices is interpreted to mean either an additional amount of work for them or a reduction in the number of employees.

As to the amount of oil required for different types of motors, I am of the opinion that where a good quantity of oil is used, which is one of the principal features and should be considered before everything else, that if fed regularly and at such a speed that it will not flood the interior of the motor, the quantity required to lubricate one motor will not be greater than another where the speed and horse-power are equal. This will be readily understood when it is explained that 2 oz. of oil is taken as a basis for the minimum quantity per armature bearing per 1000 miles, and 1 oz. of oil per motor axle bearing per 1000 miles.

Where the oil enters the motor in such quantities as to cause trouble, it is evident there is something wrong with either the kind of oil used or the quantity fed, and I would consider such practices expensive, as when such a large quantity of oil is entering the motor more is being lost on roadway.

The difficulty experienced in the past in lubricating the G.E. 800 motor is now successfully overcome by constructing an oil cup with the top projecting above the top of the grease receptacle, with a male lug cast on it for holding the oil lid and another female lug for fastening the cup to the motor with a cotter pin by means of the original male lug which held the cover, thus increasing the capacity for oil. The large number of electric lines, both interurban of high speed and long runs and city lines of slow speed and short runs, which bear testimony to the superiority of oil over grease for motor lubrication is sufficient to convince the most erratic unbeliever. The best argument in favor of oil lubrication is found in the saving of power consumed per car.

W. H. PAPE.

NOTES ON THE COMMERCIAL VALUE OF EFFICIENCY

27 William Street, New York, Dec. 28, 1905.

EDITORS STREET RAILWAY JOURNAL:

It may be of some interest to note that roughly the value per kilowatt of an average decrease or increase of efficiency in a power plant is approximately the cost of 1 ton of coal. This rule of thumb is derived as follows: Assuming the plant to be in operation during eighteen hours each day, and that the average output during these eighteen hours is 50 per cent of the full load capacity, there would be 3310 kw-hours generated per annum for each kilowatt installed. With a coal consumption of 3 lbs. per kw-hour the annual coal consumption per kilowatt installed would be 9930 lbs., and a decrease or increase in average efficiency of 1 per cent would amount to a decrease or increase of 99.3 lbs., or 0.04965 ton of coal consumption per annum. This capitalized at 5 per cent would amount to 0.993, or approximately 1 ton of coal.

The more economical the coal consumption the less is the value of the efficiency of the apparatus. As an example of this, where gas engines are installed as prime movers, the value of 1 per cent in efficiency would be only approximately ½ ton of coal. In other words, comparing a gas engine plant with a steam engine plant, the efficiency of the electrical apparatus is of relatively small importance, and this is a point which should be considered in weighing the relative advantages of the two forms of prime movers.

F. A. GIFFIN.

IMPROVEMENTS IN SAN FRANCISCO

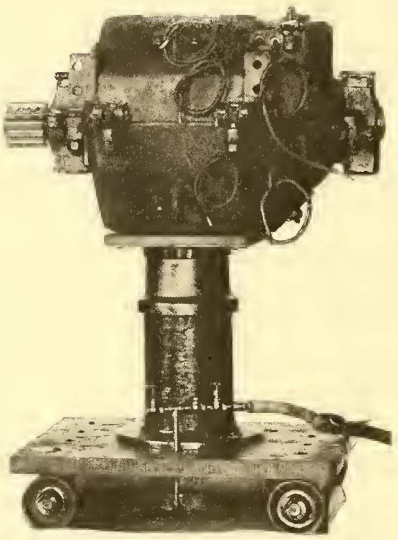
General Manager Chapman, of the United Railroads of San Francisco, has announced the details of a number of radical changes in the car service on various electric railways which he plans to inaugurate in the near future. New routes of travel for the better accommodation of residents in various outlying districts, better transportation facilities on a number of lines, the extension and betterment of the owl-car service and other like innovations are contemplated. One notable improvement decided upon is the inauguration of a through-car service to various outlying districts now reached only by transfering from one line to another. Various track connections to permit the operation of through lines over new routes have recently been completed, and the company will endeavor to demonstrate by its improved car service the advantages of an interchangeable system, which is one of the arguments in favor of a trolley line for Sutter Street.

NEW PIT JACK AT THE SHOPS OF THE INTERNATIONAL RAILWAY COMPANY

John A. Hanf, master mechanic of the International Railway Company, Buffalo, N. Y., has designed and built a novel form of pit jack for use in the repair pits of the company's Cold Springs shops. In considering the problem of fitting these shops with an efficient and at the same time economical type of jack, it was found that there were practically but two alternatives open, either to install the old style hand lever jack mounted on a truck or to adopt one of the several types of hydraulic air jacks now on the market. The idea of installing hand jacks was finally rejected as too slow and cumbersome and out of keeping with the intention to fit these shops with only the most up-to-date economical and serviceable tools. An examination of all the various forms of power jacks presented showed that to operate any of them in these particular pits, where the headroom is low, it would be necessary to have a trench in the bottom of the pit to give room for the cylinder piston when the jack table was in its low position. This trench in the pit was considered an objectionable feature in view of the likelihood of its becoming more or less of a catch-all for grease, old waste and rubbish, in addition to its hampering the pit men in their work.

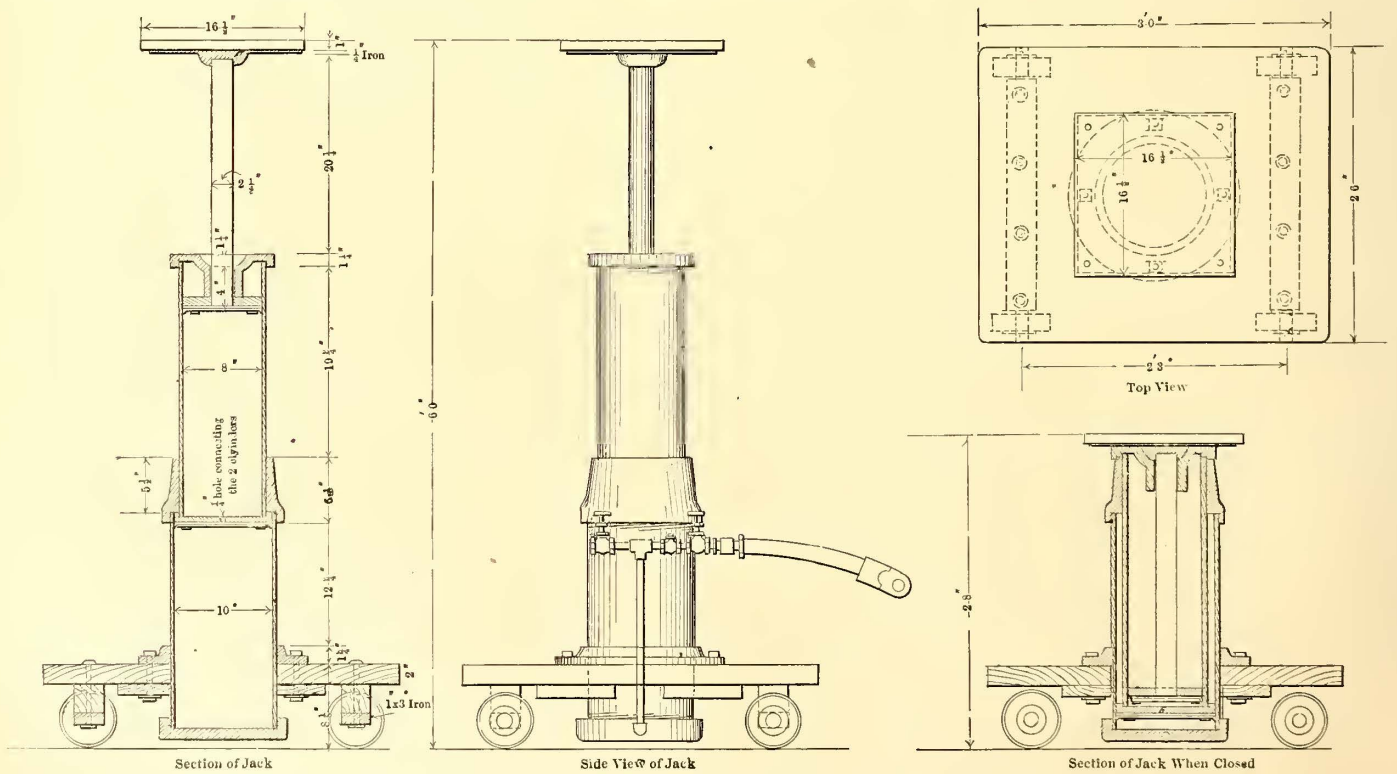
While considering this problem, Mr. Hanf conceived the idea of constructing a jack which would operate with telescoping pistons so that the necessary limits of travel could be secured without trenching or cutting the bottom of the pit. The type of jack finally designed is illustrated in the engravings. The table of the jack when lowered is but 32 ins. from the pit bottom, and when raised to its maximum height is 5 ft. 11 ins., giving a total piston travel of 3 ft. 3 ins. The jack requires no trench and takes up much less room than lever jacks. The jack shown is operated by air where air is obtainable. The same design, however, can be arranged to work with hydraulic pressure equally as well.

By reference to the drawings it will be seen that the lower cylinder consists of an iron shell about 10 ins. in diameter mounted in a small truck. The second cylinder is 8 ins. in diameter and telescopes into the lower cylinder. There is no packing between these two cylinders at the sides, the sliding contact being merely a good machine finish fit. At the bottom of the 8-in. cylinder, however, there is a steel plate with a leather gasket packing. The only passageway for air between the 10-in. cylinder and the 8-in. cylinder is a hole ¼ in. in diameter bored through the bottom of the smaller cylinder and through the steel plate and leather packing. This small hole serves all the requirements of an air valve from the lower cylinder into the upper one. The jack table is carried on a shaft 2¼ ins. in diameter made from an old car-wheel axle. This shaft telescopes into the 8-in. cylinder and has a circular plate at its lower end, as is shown. The sliding surfaces where the shaft passes through



JACK IN LOWERED POSITION

TELESCOPIC JACK RAISED TO MAXIMUM HEIGHT



PNEUMATIC PIT JACK, INTERNATIONAL RAILWAY COMPANY, BUFFALO

the top of the 8-in. cylinder are packed with air-tight bushings.

The air supply is let into the bottom of the lower cylinder, the flow of air being controlled by a small hand valve. When air is allowed to enter, the 8-in. cylinder begins to rise first until it has reached nearly its maximum height, when the air begins to flow through the ¼-in. hole into this cylinder, and the third section, comprising the shaft with the jack table, then begins to rise. The jack is lowered by closing the valve to the air supply and opening a small valve, giving exhaust to atmosphere. The raising and lowering of the jack are easily controlled by manipulating the two hand valves, and the table can be stopped and held at any point in its upward or downward travel. If it is necessary to leave the jack in its raised position with a heavy weight on the table for any length of time, this can be accomplished by closing the exhaust valve and opening the air supply valve just a trifle so that sufficient air from the main supply tank will flow in to compensate for any slight leakage or compression of air in the jack cylinders.

The 8-in. cylinder has a lifting capacity, when operated with air at 60 lbs. pressure, of 4700 lbs., and raises to a height of 52 ins. The smaller piston raises to the full height of 5 ft. 11 ins., and when operated with air at 60 lbs. will lift about 3000 lbs., supported on the jack table. The engravings show the jack lifting a GE 67 motor, complete with armature, fields and pinion. Mr. Hanf has applied for patents covering the details of the jack.

A CAR FOR LIMITED PASSENGER SERVICE

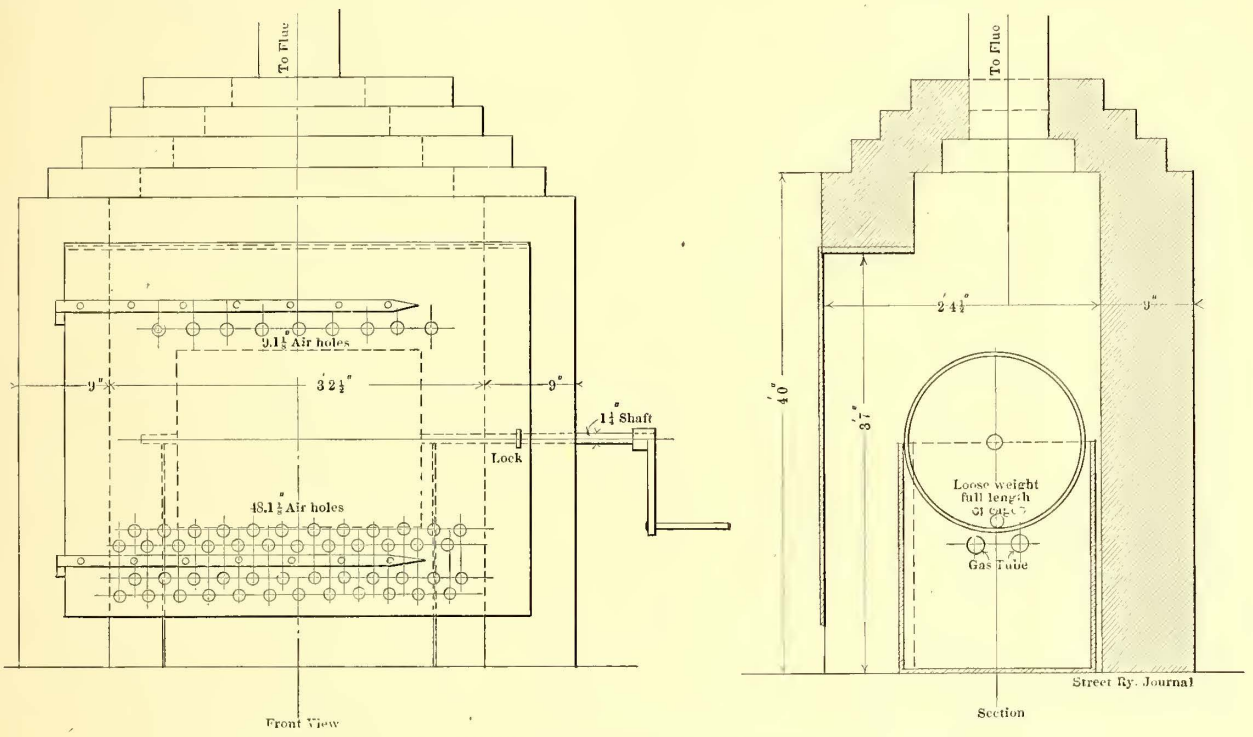
A car intended for limited service only on the lines of the Indiana Union Traction Company is being reconstructed in the shops of the company. The present limited cars have buffet heater and toilet rooms located at the partition between the main passenger and smoking compartments. In order to give passengers in the rear compartment a clear view ahead, these have been removed from their present location and a glass partition constructed. The heater and toilet rooms are located at the rear entrance of the car, and the buffet has been abandoned. The feature most worthy of note in the new car is the revolving chair seats employed. General Manager Nicholl states that if the first car is found satisfactory more will be built.

CONVENIENT ARRANGEMENT FOR DESTROYING USED TICKETS

Although seemingly a simple matter, it is oftentimes a vexing question to decide how best to destroy used tickets and transfers. Of course, it is easy enough to send a clerk from the accounting department with the tickets in bags and have them dumped into the furnace under the boilers at the power house, but a number of companies have found to their cost that this procedure leaves too many loopholes for the tickets to find their way back into the hands of the public, and it is now generally considered necessary to place as many safeguards around the tickets from the time they reach the accounting department until they are entirely destroyed as is exercised in handling the cash.

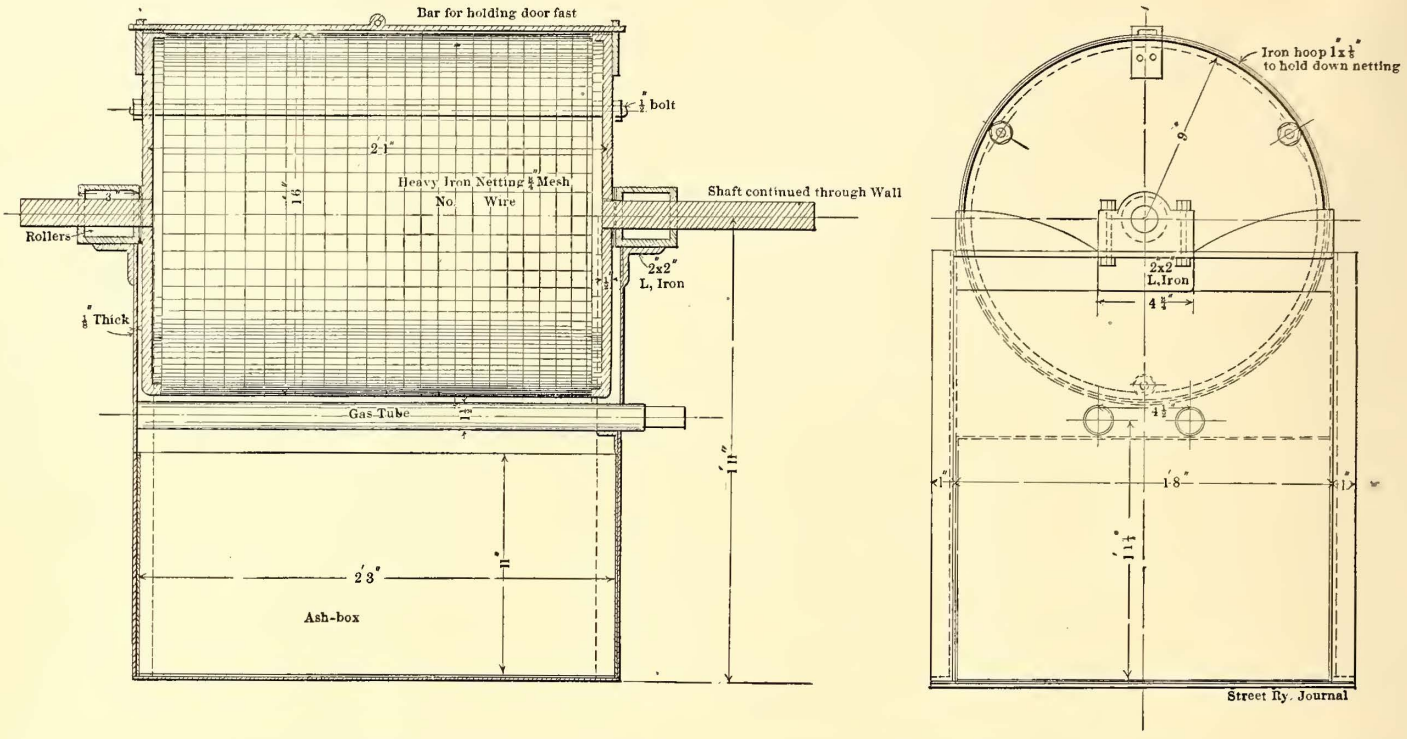
The Toronto Railway Company has devised a scheme for destroying tickets that is at once simple, economical and safe. At the side of a small furnace used for heating the office building in which the accounting department is housed has been built a small brick retort about 5 ft. high, 4½ ft. wide and 3 ft. deep, inside dimensions. Within this furnace is a cylinder formed of heavy iron netting with ¾-in. mesh, this cylinder being not unlike the ordinary wire screen used for screening broken stone. The cylinder is carried on bearings housed in the side walls of the retort, and can be revolved by means of a shaft and hand crank which project outside one of the walls. The cylinder, or screen, has a hinged section or top, through which the tickets or transfers enclosed in paper bags are packed tightly inside the cylinder. This hinged door is then closed, and locked, so that it is impossible to remove the contents without a key. Underneath the cylinder are a number of gas jets formed by punching holes in two iron gas pipes, which extend the full length of the cylinder about an inch below the bottom. The furnace itself has a heavy iron door which is fitted with a heavy padlock.

The procedure is for the cashier and one assistant to take the tickets, after they have been counted and placed in paper bags, down to the cellar and pack them into the wire cylinder. The cylinder is then closed and locked, and the furnace door is also closed, bolted and locked. The assistant then lights the gas jets under the screen, and after the flames have communicated to the paper bags the crank handle is given a few quick

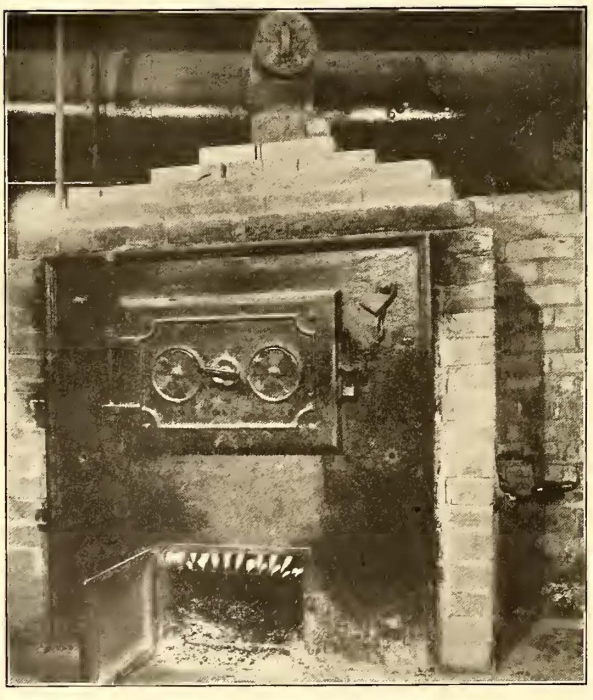


DETAILS OF FURNACE FOR BURNING TICKETS, TORONTO RAILWAY COMPANY

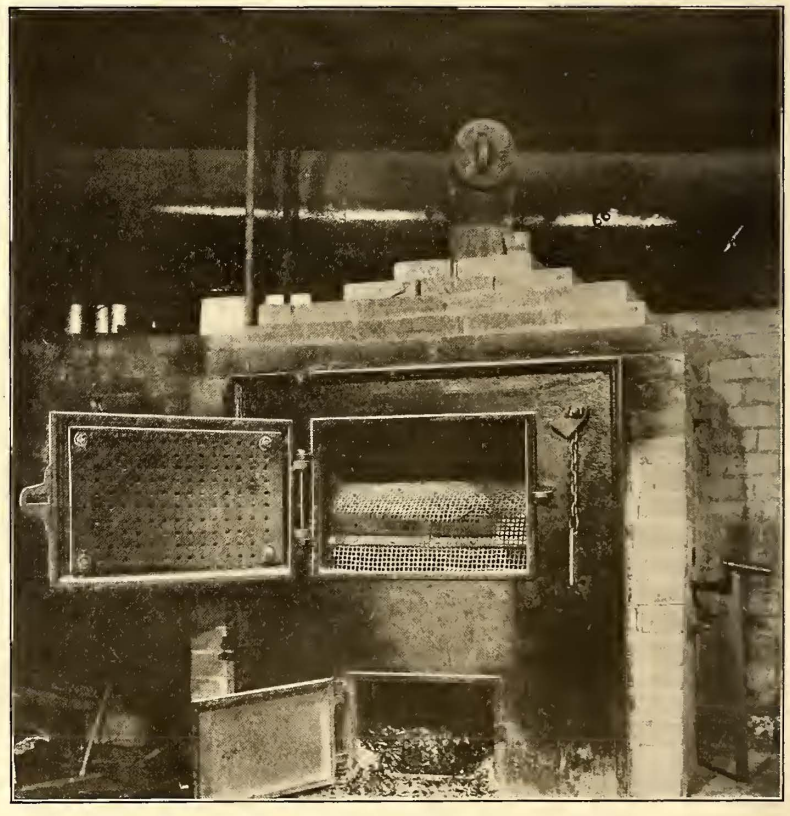
turns, thus revolving the contents of the cylinder and permitting the flames to pass through the entire mass. The gas is left burning for an hour or so, but it is not necessary to leave anyone to watch the furnace after the door has been locked, as it is manifestly impossible for anyone to gain access to the interior of the screen. To facilitate the destruction of the tickets it has been found expedient to place a loose iron bar within the cylinder, so that when the handle is turned the bar will roll around within the screen and thoroughly break up any small masses of tickets that might form and escape the full effects of the flames. The residue of a charge of tickets after burning for an hour comprises a handful of black dust, which can be readily sifted through the screen by giving the handle a few turns. In the several years this device has been in use, a piece of paper bearing any semblance to a ticket has never passed through the screen after the firing, and the officials of the accounting department never have the slightest doubt about each individual ticket being destroyed after it has once been placed within the screen. The time consumed by a responsible representative of the accounting department in overseeing the destruction of the tickets amounts simply to the time necessary to take the tickets to the cellar, pack them in the screen cylinder, lock the doors, light the gas jets and give the cylinder handle a few quick turns. The cost of destroying the tickets



DETAILS OF SCREEN CYLINDER OR CAGE IN WHICH TICKETS ARE PLACED FOR BURNING



FURNACE FOR BURNING TICKETS, SHOWING GAS JETS UNDERNEATH CAGE, TORONTO RAILWAY COMPANY



FURNACE FOR BURNING TICKETS, SHOWING SCREEN CYLINDER OR CAGE IN WHICH THE TICKETS ARE PLACED, TORONTO RAILWAY COMPANY

amounts to the expense of burning the gas jets under the cylinder for not over an hour each day. The illustrations accompanying this article give all the details and dimensions of the ticket destroyer. For the drawings and photographs acknowledgment is made to J. H. Smith, comptroller, and Robert J. Clark, assistant comptroller, of the Toronto Railway Company. It is the intention to take out letters patent covering the details of the device.

REPORT OF THE OFFICIAL TEST OF THE DOUBLE CROSS-COMPOUND ENGINES IN THE FIFTY-NINTH STREET POWER STATION OF THE INTERBOROUGH RAPID TRANSIT COMPANY OF NEW YORK

In accordance with the terms contained in the contract between the Allis-Chalmers Company and the Interborough Rapid Transit Company, governing the construction and operation of the nine double cross-compound engines in the latter's power station at Fifty-Ninth Street and Eleventh Avenue, New York, the former guaranteed certain operative results under specified conditions, in effect as follows:

Each engine was not to require more than 12.25 lbs. of dry steam per ihp per hour, when indicating 7500 hp at 75 r. p. m., with a vacuum of 26 ins. at the low-pressure cylinders, and with a steam pressure at the throttle of 175 lbs., said rating to include all steam used by the engine or by the jackets or reheater. A further memorandum agreement formulated by the representative engineers of each company governed in detail the conduct of the test; this secondary agreement being necessitated by certain features peculiar to the case involving the very essential point of the original contract.

The swing of the generator load, averaging approximately 12 per cent in three seconds plus or minus, presented a prohibitive impediment to the use of the ordinary engine indicator as a standard for results. Thus the only method practicable was to obtain the developed electrical horse-power of the unit and correct this by engine friction and generator losses as determined by subsidiary tests, these tests becoming practically of primary importance, as indicated by results of preliminary trials. The final decision was to make friction determinations by two methods, hereinafter designated and described as the electrical method and the continuous indicator method, the former to be considered decisive if checked up to within 10 per cent by the latter.

The following is a description of the conduct of the test proper and the subsidiary tests, classified as reported by the engineer in charge of each department of the test.

ENGINE TEST PROPER: ENGINE AND STEAM READINGS AND DETERMINATIONS

The engine designated as No. 8, being so situated as to permit unit isolation from the rest of the plant, was selected as representative of the complete installation. All steam and water mains and auxiliary lines in the unit were either entirely cut off from the rest of the house or separated by two valves and a bleeder or drip valve between. The unit as thus isolated consisted of seven boilers, the water ends of a boiler-feed pump and a circulating pump respectively, and the main engines.

Apparatus as required for the test was installed as follows: For weighing the total feed-water as delivered by the supply line, four tanks, mounted in pairs upon two 20-ton scales, with a capacity per pair of 28,000 lbs of water, were used. The delivery from the weighing tanks was to two reservoir tanks connected by equalizers, and then in turn to the boiler-feed pump. For weighing of drips, leakage, etc., small scales and tanks were erected as necessary. Peabody throttling calorimeters were connected to the main line, in close proximity to the throttle, for use in case of wet steam. All gages and thermometers were carefully calibrated and standardized to the satisfaction of both parties. For the purpose of correcting for changes of level of the water in the boilers, scales graduated to tenths of an inch were placed close to each gage glass, and a temporary walkway erected to facilitate readings. Floats indicated the level of the reservoir tanks, this level being maintained a constant. To eliminate the use of the calorimeters, the steam supply was maintained at a constant low degree of superheat, one boiler containing superheater coils and this operated as desired. Vacuum was maintained at an average of 26 ins. mercury. Due allowance was made for all known leakage and drips. Readings were taken at 15-minute intervals, an hourly graphical log being maintained.

ELECTRICAL READINGS AND DETERMINATIONS

The load on the engine was measured electrically, by means of four balanced three-phase integrating wattmeters of the induction type, connected to current and potential transformers, located at the terminals of the alternator and connected as follows: Three current transformers, one in series with each of the three armature conductors, and two potential transformers, connected from phases 1 to 2 and 2 to 3, respectively.

As the potential transformers were designed for use under closely defined conditions, and could, therefore, be accurately standardized by the makers, their ratio, which is 100 to 1, was assumed to be correct. In the case of the current transformers, however, where the ratio is subject to change, due to changed secondary resistance, it was considered desirable to recheck the ratios, which was done as follows:

The generator was short circuited with a standard Kelvin ampere balance in series with the current transformer in phase 1, while a portable ammeter was substituted for the regular switchboard ammeter, in the secondary side, thereby securing accurate measurement of the secondary current without altering the secondary resistance appreciably, while all other instruments having a current winding, which were to be used for the test, were included in the circuit. The generator was then run at full speed, and the excitation adjusted to cause full-load current (263 amps.) in the armature, which was found to be constant. During this period, twenty readings of primary and secondary current were taken simultaneously, by means of telephone communication between the readers of the Kelvin balance and secondary ammeter. From these corrected readings the true ratio of transformation was calculated. It can be seen that this method of test, which is made under operating conditions, will correct for any error due to inductance in the secondary circuit, caused by running the current transformer leads in iron pipes, which could not be corrected for in the original manufacturer's ratio test. This test was repeated for phases 2 and 3 under similar conditions. The calibrating watts for the four balanced three-phase wattmeters were calculated from the corrected transformer ratios, and the meters calibrated and adjusted by comparison with Weston standard wattmeters, the calibration of which will be described later.

The meters were connected as follows: One in the secondary of the current transformers in phases 1 and 3 respectively, and two in that of phase 2, the object of this method being to show by the readings of the meters in the three phases that the load was balanced, while the object of the two meters in a single-phase was to furnish a continual check on the calibration of the meters. It was found that all meters agreed within their limit of precision, and results were therefore calculated from the average of the readings of the four meters, which was taken to be the true output of the generator in kw-hours.

FRICTION DETERMINATION AND ELECTRICAL LOSSES (ELECTRICAL METHOD)

The combined losses in the unit were ascertained by driving the generator as a synchronous motor with the engine trailing, and measuring the watts input, which it can be seen would consist of combined friction and windage, I^2R losses and iron losses. As this input was too small to be measured accurately by means of the four lead meters, a special meter with its standardized current transformer was used. The unit could not be motorized for periods longer than 5 minutes, because of the difficulty in lubricating the cylinders, which was not long enough to give a dial reading on the meter; so the meter during the short run was read by counting the revolutions of the disc, timing same with two chronograph watches reading to tenths of a second, and the mean kilowatt figured by the usual calibrating formula. During this period, the field current was held at that value corresponding to full-load excitation, in order to make the iron losses the same as at full load, and was read on a Weston standard portable ammeter. The armature volts and amperes were also read at 10-second intervals, in order to obtain the power factor, which, due to the over-excitation of the field at such small load, was low, averaging for the several trials 18.5 per cent with a leading current. As the meter used for this test was calibrated at a power factor of 1.0, it was necessary to check it on low values, and readings were, therefore, taken with a leading current at ten points from 0.1 to 1.0, and a curve plotted, showing the error, which curve was used to correct all readings taken on the friction trials. To this corrected input, as the armature current was below full-load value, must be added the difference between the I^2R losses at the observed value and that corresponding to full-load current. From the above, the output of the generator plus the input to the generator motorized, plus the difference between the I^2R loss at motor current and the same at full-load current, equals the total load on the engine in kilowatts.

CALIBRATION OF METERS USED DURING TEST

The Kelvin ampere balance used for the ratio tests was compared with a potentiometer and standard resistance. The ammeter for the secondary current was compared with the current dynamometer, standardized by means of potentiometer and standard resistance. The current transformer for the friction trials was checked by comparison with a Kelvin ampere balance. The standard indicating wattmeters, used for calibrating integrating wattmeters, checked by comparison with the Weston laboratory standard voltmeter and potentiometer and standard resistance. The Weston standard portable shunt and millivoltmeter was checked by comparison with potentiometer and standard resistance. The work of calibrating the standards was performed by the Electrical Testing Laboratories, of New York, in all cases, and in addition, by comparison with the Interborough Rapid Transit Company's own standards whenever possible, in all of which cases the same agreed within the limits of precision of the instruments tested.

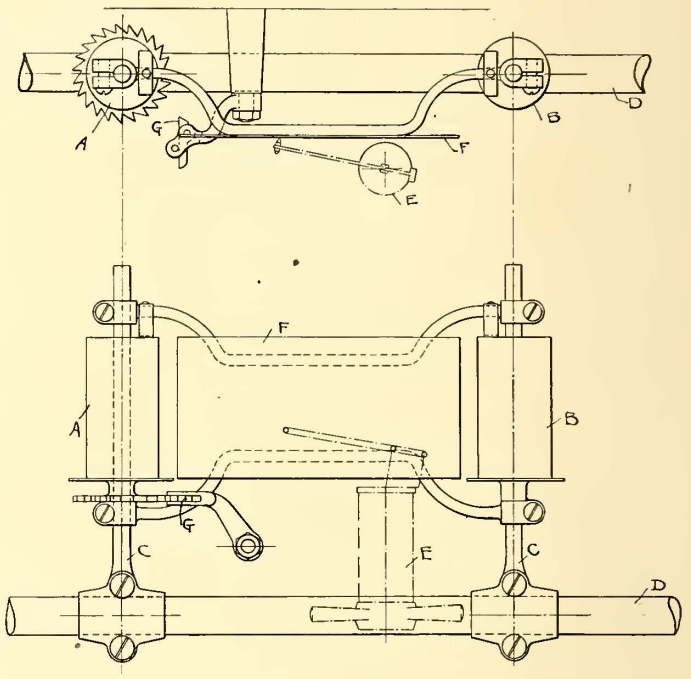
FRICTION DETERMINATION BY CONTINUOUS INDICATOR METHOD

For this purpose a continuous indicator was designed by W. L. Seabrooke, of the Interborough, which instrument solved the problem of indicator application to the engine.

The device consists of two drums "A" and "B," turning freely on spindles "C"-"C," mounted on the mandrel "D," which has a reciprocating movement in front of the indicator "E," the latter being of regular standard design, except for the removal of the drum. A strip of paper, winding on "A" from "B," passes over the plate "F," thus presenting a flat recording surface. As the back pressure line is traced, the ratchet "G" contacts with the toothed wheel under the drum "A," causing it to rotate a fixed distance. This movement defines the distance between successive cards, and can take place at any point of the stroke desired. As the back pressure line is usually straight no error is introduced, and the cards present the same appearance as if taken singly. The operation is automatic, and records a card for each revolution, to the extent of the paper supplied by the drum "B." Using this device, two sets of indicator cards were taken on the engine running empty; one for a period of 2 minutes with an exciter current of 165 amps., and the other for a period of 1½ minutes without the exciter.

LEAKAGE TEST

A leakage test of boilers, and boiler-feed and steam lines to the engine throttle were made 36 hours subsequent to the official engine trial, said test being of 24 hours' duration. In connection therewith, water was weighed and fed to the boilers



CONTINUOUS INDICATOR DIAGRAM DEVICE

by way of the reservoir tanks, as in the engine test. Due allowance was made for all known leakage and drips, and correction made for change in boiler level.

RESULTS OF FRICTION TRIALS (ELECTRICAL METHOD)

1. Volts armature by switchboard meter, 10,510 volts.
2. Amperes armature by switchboard meter, 119. 6 amps.
3. Amperes field by Weston standard, 202. amps.
4. Kilovolt amperes armature $3 \times (1) \times (2)$, 2170 k. v. a.
5. Power factor, $(6) \div (4)$, 18.55 per cent.
6. Kw input, $\frac{427.4}{106.1} \times 100$, 402.5 kw.
7. I^2R on test $(119.6)^2 \times (11)$, 4.12 kw.
8. I^2R at full load $(263)^2 \times (11)$, 18.92 kw.
9. Difference between $(7) + (8)$, 14.8 kw.
10. Total losses $(6) + (9)$, 417.3 kw.
11. Resistance of armature at 30 degs. C, 2877 ohms.

The value 417.3 kw is therefore added to all full load output readings, to obtain total load on the engine.

RESULTS OF FRICTION TRIALS (CONTINUOUS INDICATOR METHOD)

1. With exciter current, engine empty, 580.78 ihp.
2. Without exciter current, engine empty, 432.7 ihp.

RESULTS OF ENGINE TRIAL

A summary of the test results, with averages, is as follows: Test, Dec. 6. 1905.

Duration, 15 hours.
Preliminary operation on load, 2 hours
Load (switchboard reading), 5079.2 kw.
Friction and electrical losses, 417.3 kw.
Total load, 5496.5 kw.
I. H. P., 7365.3.
R. P. M., 75.02.
Steam pressure, 175.18 lbs. (gage.)
R. H. receiver pressure, 19.1 lbs. (gage.)
L. H. receiver pressure, 19.27 lbs. (gage.)
Vacuum, 26.02 ins.
Barometer, 30.5 ins.
Temperature injection water, 42.36 degs. F.
Temperatur R. H. discharge, 74.05 degs. F.
Temperature L. H. discharge, 77.38 degs. F.
Water per hour, 89,906 lbs.
Weighed leakage per hour, 512 lbs.
Leakage per hour (leakage test), 1470 lbs.
Boiler level correction, per hour, 60 lbs. (high.)
Net water per hour, 87,864 lbs.
Correction for superheat, 28 per cent.
Equivalent dry steam per hour, 88,110 lbs.
Dry steam per kw-hour (switchboard), 17.34.
Dry steam per ihp per hour (engine), 11.96.

The tests were under the supervision of Frank N. Waterman, who acted as referee. The following represented their several companies: Interborough Rapid Transit Company—H. G. Stott, superintendent motive power; J. Van Vleck, mechanical engineer; H. W. Butler, principal assistant engineer; Thomas Allsop, mechanical engineer, Fifty-Ninth Street power station; C. W. Ricker, electrical superintendent; G. F. Chellis, instrument man; W. L. Seabrooke and W. S. Finlay, assistant engineers.

Allis-Chalmers Company—A. M. Mattice, chief engineer; Samuel Moore, district superintendent of erection; T. T. Hubbard, engineer test; J. E. Lord, sales representative; C. A. Hoppen and C. J. Larsen, construction department; A. F. Rolf and F. Buch, electrical representatives.

EAST BOSTON TUNNEL FIGURES

The Boston Elevated Railway has turned into the treasury of the city of Boston $83,004.44, representing the 1-cent toll which the company collects from those using the East Boston tunnel. The company has also paid to the city as rental $35,000, which represents ⅜ of 1 per cent of the gross income of the company for the nine months ended Sept. 30. The gross income of the company for the nine months was $9,332,800.

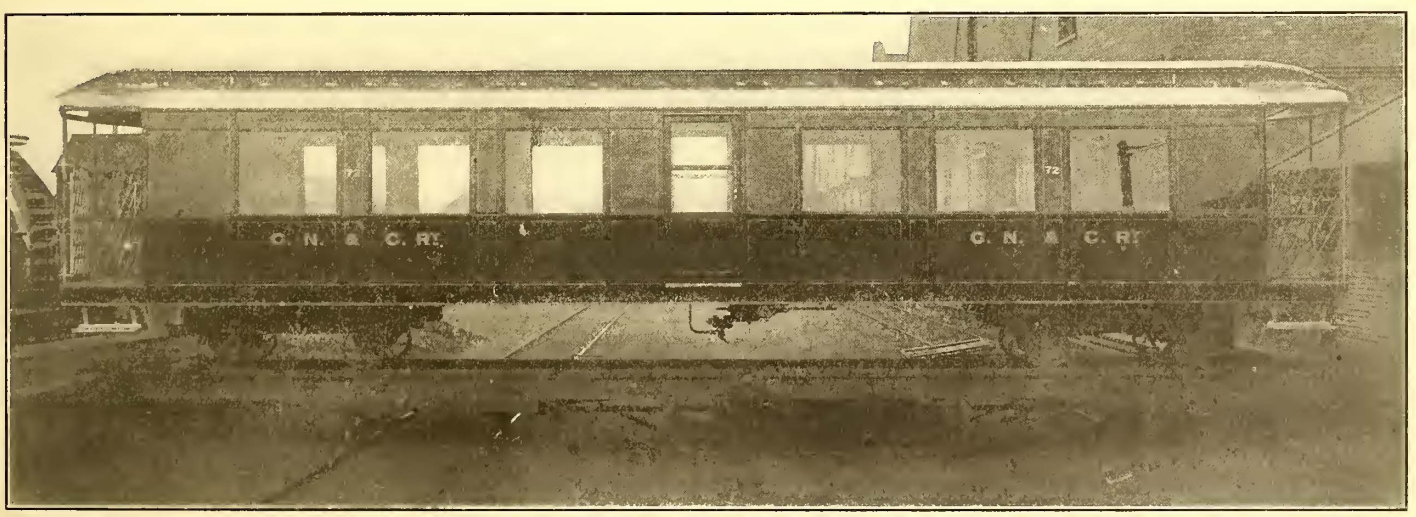
STEEL CARS FOR THE GREAT NORTHERN & CITY RAILWAY

The practice of using steel cars for subway work is as general in England as in the United States. An account was published in the Dec. 2 issue of the new steel cars recently built by the Brush Electrical Engineering Company for the Great Northern, Piccadilly & Brompton Railway, one of the Yerkes lines in London. The accompanying engravings show views of some cars recently completed by the same manufacturers for the Great Northern & City Railway, another of the underground lines in London.

INTERIOR OF GREAT NORTHERN & CITY CAR

In the eighteen cars now under construction for this railway, the under-frame, corner posts, intermediate pillars, carlines and outside panels are entirely of steel. The floor is of sheet-steel covered with a 1-in. layer of lito-silo, a non-inflammable composition, chiefly consisting of whiting, cork-dust, iron oxide and cement. This material has the same appearance and resiliency of linoleum, but is not affected by heat or cold, and has a high coefficient of friction, so that passengers can easily keep on their feet when the car is moving. The seat-legs are of malleable iron. The inside paneling is of aluminum sheets 1-16-in. thick, running as high as the roof-rail. There is no inside finish on the roof, the car lines being made of channel steel. The seats are of the spring type, built upon an iron frame and covered with rattan.

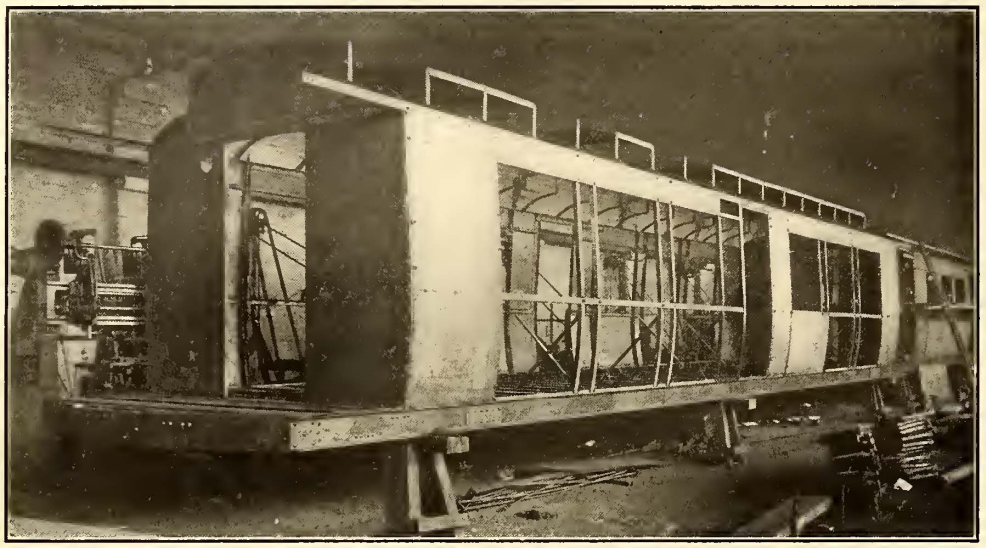
The electric light wiring is encased in highly polished brass



BODY OF GREAT NORTHERN & CITY STEEL CAR

tubes, attached to the car-lines at the base of the clerestory roof on either side of the car. The brass parcel-racks, door-handles and hand-rents on the seats have a distinctly ornamental effect. An important feature in the design is the absence of hanging straps for standing passengers. The small quantity of wood used in the car, chiefly for ornamental purposes, could be dispensed with if required, but it does not affect the absolute safety of the car from fire.

There is nothing in the appearance of the car to indicate that it is made of metal, all rivets, etc., being concealed by the ornamental features. The exterior is painted the color of teak,



STEEL CAR FOR GREAT NORTHERN & CITY. CAR UNDER CONSTRUCTION

picked out with Indian red and gold. Inside all ornamental details are of teak shown in the natural grain. The roof is painted white and the sides cream. The floor is the color of terra-cotta.

The number of passengers that can be seated is sixty-four; but each passenger has more room and the aisles are wider than in a wooden car, as although the overall width is only 9 ft. 4 ins., the same as in the cars now running on the Great Northern & City Railway, the sides are less than half as thick, so that the passengers get the benefit of the extra space left inside.

To keep the weight of the vehicle as low as possible, the full depth of the side has been utilized as a girder, thus securing great stiffness with the minimum material. As a high factor of safety is essential in rolling-stock, no part of the structure is stressed higher than 9000 lbs. per sq. in. of section.

The corner and door pillars are of angle-steel section, and the intermediate pillars of channel steel, shaped to the proper curvature of the side and flanged at the ends, to suit the top and bottom member of the girder, to which they are well riveted. In addition to the top and bottom members, which are of angle and channel steel respectively, and extend the whole length of the car, there are two intermediate members extending between the corner and side-door pillars in one piece, notched out to receive the intermediate pillars and riveted thereto. These members are arranged to receive the window frames, the upper rail being of angle section, and the lower, or waist, rail of channel section. The side body panels are ⅛ in. thick, those adjacent to the corner and door pillars being in one piece from top to bottom. The panels are well riveted to all the side members, the rivets being arranged in the corners to form a strong gusset. To stiffen the sides against the lateral stresses, diagonal braces of T-section steel are arranged in the backs of the double seats, riveted to the waist rail of the sides and to the longitudinals of the underframe.

The load is transmitted to the side girders by means of longitudinals of girder section weighing 5.4 lbs. per foot, which, in turn, are supported on cross bearers of similar section weighing 11 lbs. per foot. The cross bearers are secured to the tension member of the side girder by angle-iron knees, suitably riveted. The main bolsters are each designed to take the combined stresses due to the weight of car and of the passengers, and also the stresses set up by buffing and hauling. They are built up of two channels weighing 32 lbs. per foot, with the side brace-plates riveted thereto, and further strengthened at the center by steel forgings which are utilized to take the king-pin for the trucks and also for the draw gear. The side bearings on the bolsters are pressed from ⅜-in. steel plate and are fitted with ½-in. renewable wearing faces. The center bearings are arranged so that they may be lubricated from the interior of the car.

The underframe is braced against diagonal stresses by means of a steel floor plate 3-32 in. thick, riveted to the upper flanges of the member. This plate is strengthened by transverse flanged troughs ⅝ in. high and made from No. 16 S. W. G. sheet steel, the flanges serving to prevent the lito-silo floor covering from cracking or rising from the floor plate. The draw gear is the Great Northern & City standard type, modified to suit the special features of the cars, the whole of the stresses being transmitted to the main bolster through a cast-steel girder section bar and the king-pin. The principal dimensions are as follows.

Length over body	41 ft.
Length over platforms	49 ft. 6 ins.
Width over pillars	9 ft. 2⅞ ins.
Extreme width	9 ft. 4 ins.
Height from floor to roof	8 ft. 5 ins.
Height from rail to top	12 ft. 4½ ins.
Gage	4 ft. 8½ ins.
Wheel base	6 ft. 1 in.
Truck centers	34 ft. 6 ins.
Diameter of wheels	3 ft.
Seating capacity	64
Weight of car-body	23,912 lbs.
Weight complete with trucks, but without electrical equipment	39,368 lbs.

The trucks are of the standard Brush type as at present in use on this railway.

NEW PASSENGER CARS FOR THE CHICAGO & MILWAUKEE ELECTRIC RAILWAY

The new cars for the Chicago & Milwaukee Electric Railway Company will be built by the Jewett Car Company. The cars, of which there are to be ten, will be constructed after designs worked out in the offices of the railway company. They are to be much larger than any closed car now in use on the system, measuring 52 ft. over all and seating fifty-six passengers. The interior will be divided into two compartments, a main passenger compartment seating forty people and a smoking room containing seats for sixteen passengers. The arrangements for the hot-water heater, which will be placed in the smoking compartment, are such as to permit its removal during those seasons of the year when it is not needed, a double seat being inserted in its place.

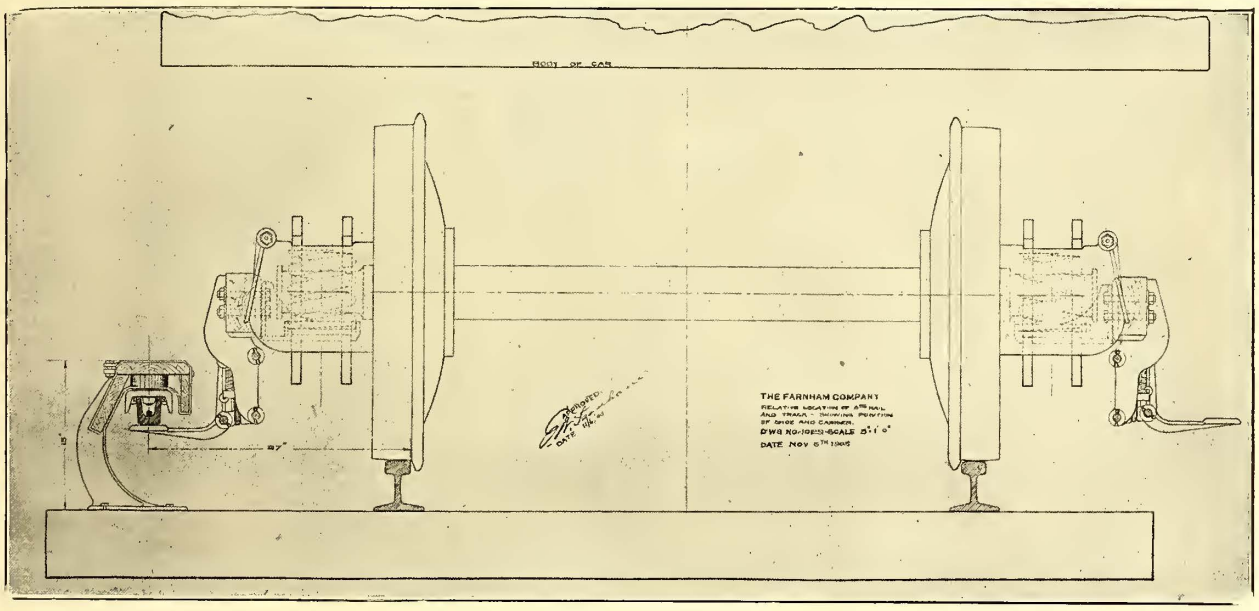
All of the longitudinal sills of the bottom framing will be reinforced by either I-beams or channel beams. The type M control will be employed, and the trucks will be fitted with four General Electric No. 73 motors.

THE FARNHAM PROTECTED THIRD-RAIL SYSTEM

The inverted third rail being installed upon the Philadelphia & Western Railroad, referred to on page 1088 of the STREET RAILWAY JOURNAL for Dec. 23, 1905, is what is known as the Farnham protected, inverted third rail, and is such a radical departure from the usual type of third rail that the operation of the road will no doubt be watched with unusual interest. The rail is the invention of E. W. Farnham, of the Farnham Company, electrical engineers and railroad contractors, Chicago, and its general designs may be understood from the illustration. The upright support brackets of malleable iron are securely fastened to the ends of the ties by lag screws, at intervals of 8 ft. The rail, of "U" shape, is provided with flanges at its two sides, by which it is suspended from the support brackets in a manner that effectively insulates it from the support brackets and at the same time permits the rail to move longitudinally, thus providing for the usual expansion and contraction. Sufficient allowance is made in the hanger for the rail to take up all vibration and jar between the iron hanger and steel rail, caused by the passing of trains upon the track rails. The method followed is claimed to be superior to that of supporting the rail in or on any insulation of a crystalline nature under tension, as it avoids all tendency to direct vibration, jarring or pounding between the insulating material and the steel rail.

Efforts to avoid these conditions and provide a method of suspension having stability and durability resulted in the form now being constructed, and also in the production of an insulator consisting of a fibrous vegetable compound, said to be of great mechanical strength, fire-proof and of high dielectric strength. A compressional, rather than a tensional strain is exerted upon the insulator by the method of suspension of the rail. An insulating bushing is fitted into a cup cavity in the top of the support bracket. A steel bolt passing through the steel washer at the top of the bushing, thence through the bushing and the insulator, engages the rail hanger by a screw thread, which, when screwed up tight, suspends the rail in the hanger. The rail, hanger and bracket are thus thoroughly insulated from the support bracket. As a further protection, after the bolt has been screwed up tight, the cup in the top of the bracket is poured full of the insulating compound in liquid form, which eliminates all danger of a foreign substance causing a ground or short circuit, and at the same time prevents the bolt working loose. The "U" shape form of the rail permits the carrying of copper reinforcing wires in the groove, for the purpose of providing additional carrying capacity. When employed, such reinforcing wires are laid bare of insulation directly within the groove, and low-resistance contacts are made by a compound plastic bond at all rail-joints, thus bonding the reinforcing wire and the rail-joints at the same time.

The rail itself is of very soft steel, and is made especially for this section for the purpose of providing a section of very high conductivity. Protection is given the rail by three planks, each of sufficient length to extend between two of the upright support brackets, and fitting into recesses or pockets in the brackets. The top plank retains the other two in position, and a casting called the cover lock, which covers the joint between two adjacent top planks, locks all of the protecting planks in position. The cover is so arranged that snow instead of piling up underneath, will be blown through, leaving the space under the rail clear and unobstructed. The boards are all dipped in an insulating compound of a fire-proof nature before being put in place.



SECTION OF TRACK AND AXLE, SHOWING THIRD-RAIL SYSTEM

A special type of shoe-carrier and collector is used in connection with this underrunning contact rail, which gives a parallel motion at all times, and consequently a perfect contact with the under surface of the rail, and an even wear upon both the rail and the shoe.

During some days, since the beginning of the holiday shopping season, the New York Subway has carried from 510,000 to 514,000 passengers, while the average for many days past has been something over 500,000 daily. Naturally enough, the underground has had some effect upon the elevated roads, as in the case of Monday, Dec. 11, for instance, when the elevated traffic recorded 730,000 passengers, a decrease of 27,000 from the same date in 1904. At the same time, the increase for that day over Dec. 11, 1904, in subway travel was 302,000 passengers, showing that the underground is not only taking the overhead, but the surface companies as well. However, the fact should be remembered that several thousand people now live along the line of the subway, or near it, that did not live there a year ago. The Interborough Company is now carrying an average of 1,250,000 persons daily, compared with about 1,060,000 a year ago at this time. Traffic figures for the early part of December, so the records show, generally hold good as an average until May, which means that the monthly gross earnings will show an increase of over $250,000.

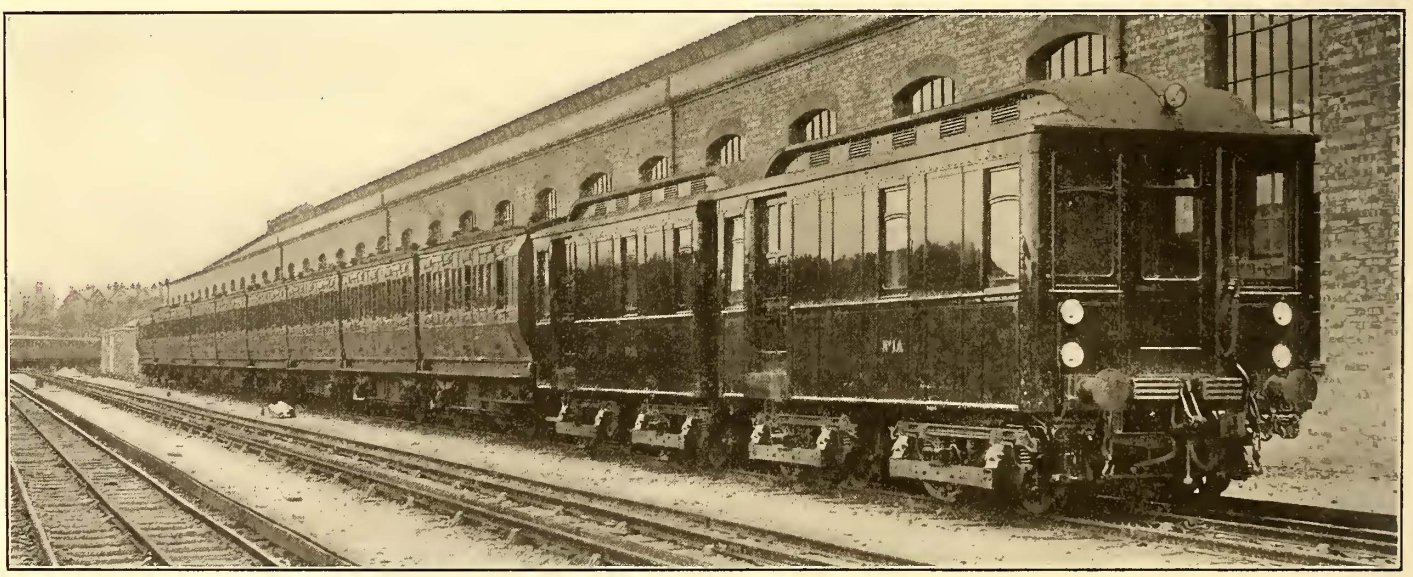
ELECTRIC LOCOMOTIVES FOR LONDON & NORTHWESTERN CARS IN LONDON

From frequent articles in this paper and from notes in the monthly "London Letter," the readers of this journal are undoubtedly familiar with the fact that the electrification of the Metropolitan District Railway Company, which is a portion of the old Underground Railway system of London, has now been practically completed. The steam-drawn trains, composed of coaches with the usual first, second and third-class compartments, have been withdrawn and long, center-aisle cars equipped with the multiple-unit system have replaced them. As is also well known, a portion of the underground railway system has long been used also by the trains of the London & Northwestern Railway Company, one of the British trunk lines. The trains of this company start from the Broad Street station in the city and run on an open railway around the north of London to Willesden Junction, where they cross the main line of the London & Northwestern Railway Company and run to Earl's Court before they actually enter the trunk system.

DISTRICT RAILWAY LOCOMOTIVE IN TWO UNITS

This portion of the London & Northwestern Railway Company's track has not been equipped electrically, and as the cars used on this line were modern and lighted by electricity, it was decided to be unnecessary to change the rolling stock. At the same time, the managers of the Metropolitan District Railway Company naturally did not wish any steam-drawn trains in their tunnel after their own system of electrification was complete. It was decided, therefore, that electric locomotives should be used to draw the London & Northwestern trains through the tunnel. These locomotives are attached to the trains at Earl's Court station and draw them the remaining portion of their journey from this station to the Mansion House station. Views of a locomotive unit and of a complete train of cars are presented herewith.

The locomotive bodies and trucks were built by the Amalgamated Railway Carriage & Wagon Company, of Birmingham. The electrical equipment was furnished by the British Thomson-Houston Company, of Rugby, England, and consists of B. T. H. type GE-69 motors, similar to those used on the other underground trains in London. The Sprague-Thomson-Houston multiple-unit system of train control is used. Each of the two locomotives attached to each train is supplied with four motors, and each motor is of 200 hp, so that the total per locomotive is 800 hp. The combined weight of the two locomotives shown in the illustration is about fifty-six tons, or seven tons on each driving axle. The weight of the London & Northwestern train, with load, is approximately one hundred and forty tons.

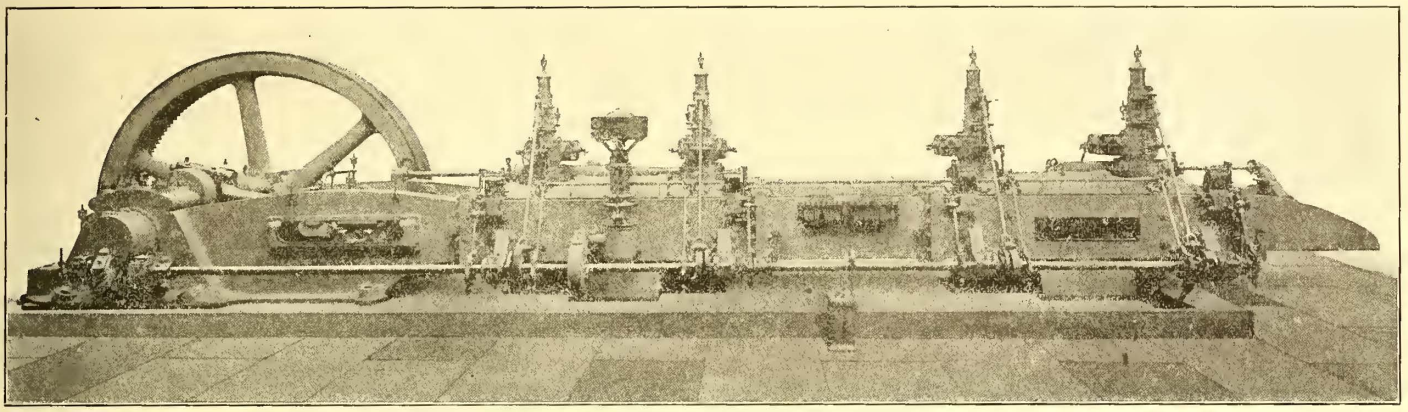


TRAIN OF LONDON & NORTHWESTERN CARS, WITH DISTRICT RAILWAY LOCOMOTIVES

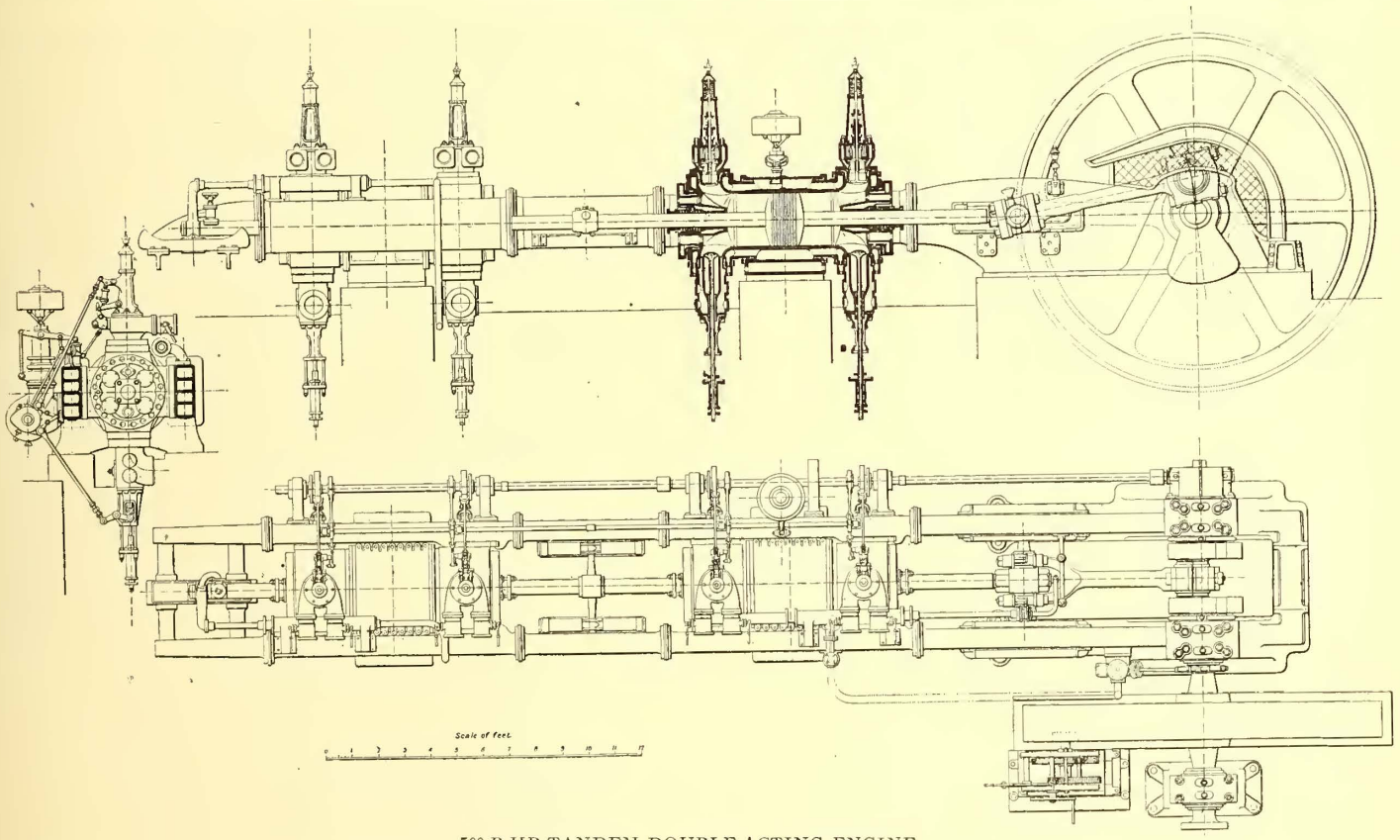
Before the Circuit Court of Monroe, Mich., the Toledo, Ann Arbor & Detroit Railway recently won an interesting decision against the Michigan & Ohio Railway Company. The first-mentioned company has a road well under way between Toledo and Ann Arbor. Some time ago it attempted to condemn right of way through the property of one Perry Closer, of Petersburg. It is claimed that Closer and associates organized the Michigan & Ohio Company with the avowed purpose of building a line from Petersburg to Dundee, a distance of 7 miles, but that in reality they aimed simply to take advantage of an old Michigan law which prevents one road from condemning the right of way of another road until it had been unused for five years. The court held that the complainant company was conceived in fraud, that it had no intention of building a road and that it existed simply for the purpose of holding up the other company, whose line had been surveyed and mapped out through the property two years before the complainant organized a rival company.

A 500-B.HP. GAS ENGINE

The progress that is being made by the gas engine is well exemplified in the type shown in the accompanying illustrations of an engine built by Richardsons, Westgarth & Company, Ltd., of Middlesbrough, Eng., who manufacture the well-known Cockerill type gas engine, under license from the Societe Anonyme John Cockerill, Seraing, Belgium. This engine has two double-acting cylinders, which are 23⅝ ins. in diameter by 31½-in. stroke, placed tandem, and is now driving one of Brown, Boveri & Company's continuous-current generators, direct coupled to the end of the crankshaft and running at 125 r. p. m.



SIDE VIEW OF 500-B.HP GAS ENGINE



500-B.HP TANDEM DOUBLE-ACTING ENGINE

The engine was originally built for the electric station of the builders, but as soon as it was set to work it was purchased by the Cargo Fleet Iron Company, Ltd., of Middlesbrough, at whose works it is now installed, and where it is driven by ordinary blast furnace gas, which is cleaned by a Theisen rotary gas cleaner. This apparatus is also manufactured by the engine builders, and has proved to be entirely satisfactory in operation, as it cleans the gas so that it does not contain more than .02 grammes of dust per cubic meter. As gas engines run very well even with gas containing up to .1 gramme per cubic meter, the use of this apparatus eliminates all the trouble experienced in gas engines due to the presence of dust, etc.

The engine works on the Otto cycle, and as it has double-acting cylinders, it receives one power impulse every stroke—that is, two impulses per revolution, like a steam engine. As will be seen from the illustrations, the gas and air valves are placed on top of the cylinders, thus making them most accessible. The exhaust valves are placed below, and one set of cams on the side shaft controls each complete set of valves, thus reducing the working parts to a minimum and making them very accessible. The cylinders are fitted with loose covers at each end to facilitate overhauling the valves and to enable the pistons to be drawn and examined very quickly. .

In the arrangement of the longitudinal side frames carrying the cylinders, special attention has been given to allow for expansion and contraction to avoid undue strain being set up in the cylinders. This is secured by carrying the side frames continuously from the crankshaft to the end of the engine, the gas cylinders being secured to these side frames at one end only, and so arranged that they can be removed bodily without disturbing any other heavy part.

The engine is controlled by a special governor regulating

the amount of gas admitted to the cylinders; a constant compression is also maintained, independent of the load on the engine, to balance the inertia of the reciprocating parts, which insures steady running with a moderately heavy fly-wheel. Many of these engines are running in parallel with other steam and gas-driven engines driving alternators. The speed variation from normal to light load does not exceed 7½ per cent, and arrangements are made so that the speed of the engine can be altered 5 per cent while running.

In designing this engine, great care has been taken to insure efficient cooling; the cylinders with their covers and the pistons, piston rods, and exhaust valves with their chambers, also the main bearing bushes, are water cooled. A special pump, driven by eccentric from the crankshaft, circulates the water through the pistons and piston rods at a pressure of about 40 lbs. The cooling water for the pistons passes through the center of the piston rods, and is taken away at the back of the engine through the non-return valve shown.

The piston rods are made of forged ingot steel, having double cast-iron slides lined with best quality white metal on the working faces. The connecting rod is of the marine type, made of best forged ingot steel, having very large adjustable bearings at both ends, and these are lined with best quality white metal. The crankshaft is a built-up shaft, the body and pins being of forged ingot steel, and the webs of cast steel with balance weights cast thereon. This shaft is carried in two large main bearings, having separate cast-iron bushes lined with white metal. An outer bearing is also provided outside the fly-wheel next to the generator.

This engine is fitted with an improved Bosch magneto ignition, and in all subsequent engines two sets of this gear will be provided for each explosion end of each cylinder to insure certain firing and quick combustion of the gas mixture. For starting the engine, compressed air is used, drawn from a suitable reservoir.

These engines are specially designed for using ordinary blast furnace gas, in which case the compression pressure is kept high, which insures very quick combustion. This is a very important point, especially when the engine is running on light loads with corresponding weak explosive mixtures. By reducing the compression, richer gases can be used without danger of pre-ignition. The consumption of gas depends, of course, upon its calorific power. Where ordinary blast furnace gas is used, this is about 95 cu. ft. per British horse-power per hour. For producer gas the consumption is about 65 cu. ft. per British horse-power per hour.

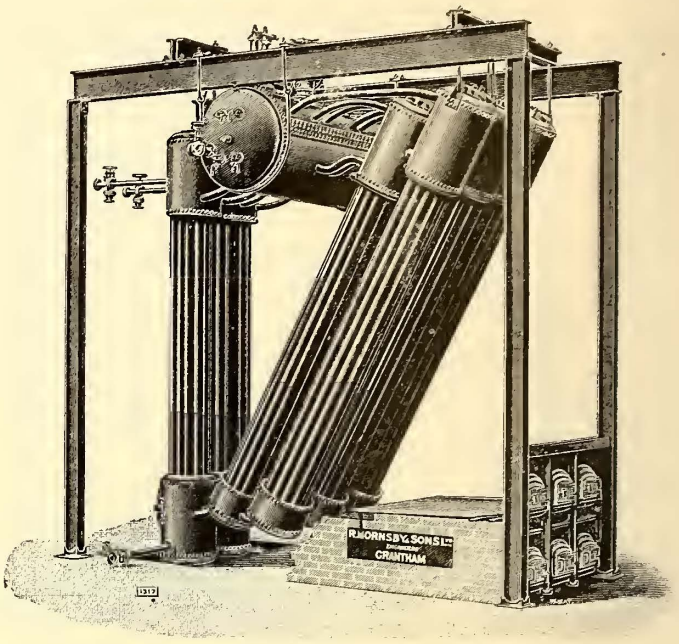
The makers of this engine have installed over 140,000 ihp in units up to 2200 ihp, and have now in hand two sets of 1200-B.HP. gas engines for rolling mill work, each engine having four double-acting cylinders, arranged in pairs, with two cranks and a heavy fly-wheel between them. These engines are to use Mond gas. They also have in hand several other large engines to use producer, coke oven and blast furnace gas.

A RECENT INTERURBAN MAP OF INDIANA, OHIO AND ILLINOIS

A map showing the extent to which the interurban railway has been developed in Indiana, Ohio, Illinois and Southern Michigan has been gotten out by General Manager Nicholl, of the Indiana Union Traction Company. All the interurban lines operating in the States named are shown in red upon a green background. The issuing of such a map is a rather unselfish move on the part of the Indiana Union Traction Company, as all the other lines shown will also be benefited. However, the increased travel induced over the company's own lines, by reason of the fact that connections with other lines are well shown, is a sufficient incentive for its publication.

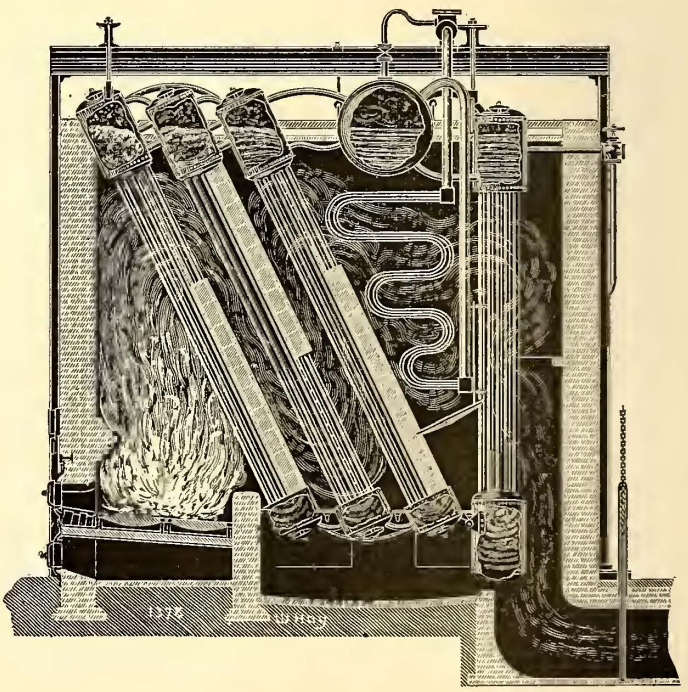
A NEW UPRIGHT BOILER

The accompanying cuts illustrate a new type of boiler now being put on the market by Richard Hornsby & Sons, Ltd., of Grantham, Eng., and which has been designed specially to



SIDE VIEW OF 390-HP WATER-TUBE BOILER, SHOWING GENERAL ARRANGEMENT, HANGING SECTION, COMBUSTION CHAMBER AND ECONOMIZING SECTION

take the place of the company's old horizontal type. This boiler can be made in very large sizes (up to an evaporative capacity of 100,000 lbs. per hour) without constructional difficulty, making it eminently suitable for the requirements of a

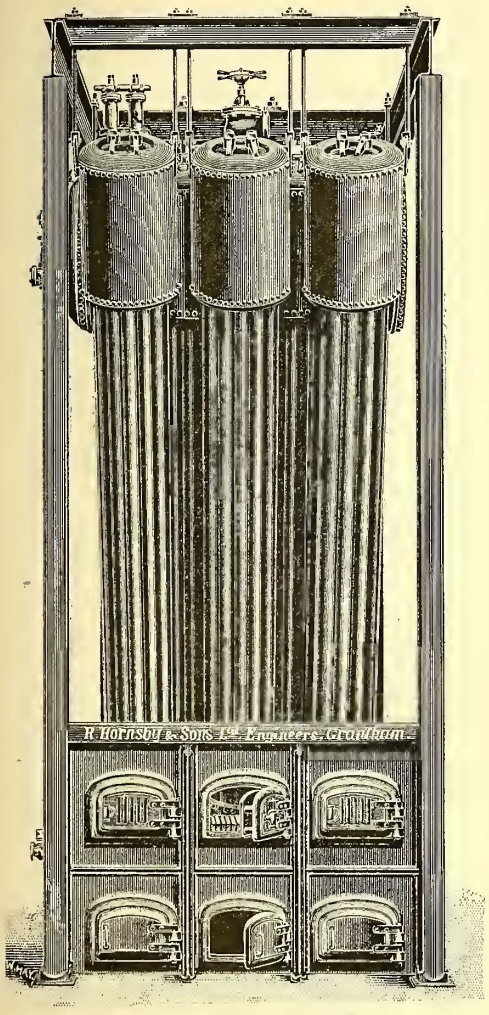


A SECTION OF UPRIGHT WATER-TUBE BOILER, SHOWING COURSE OF HOT-WATER GASES, COMBUSTION CHAMBER, SUPERHEATER AND GENERAL ACTION

modern central power station, with larget turbine units and and other gas engines.

The unique feature of this boiler lies in the fact that the whole boiler can be laid open for inspection by the removal of a small number of doors, for instance, in the 730-hp size, by the removal of only fourteen covers.

This upright water-tube boiler was designed to overcome the difficulties experienced with the old horizontal type, viz., the deposit of sediment in that part of the boiler which should be the most efficient (the lower rows of generating tubes), causing rapid loss by steaming power and efficiency, and making the use of the old type boiler for long periods without cleaning undesirable, unless exceptionally clean or distilled water was used. The feed-water being delivered to the back or least active part of the boiler, is relieved on its passage downward through the tubes of the bulk of its impurities, which are deposited in the form of liquid mud in the bottom back headers. What little sediment does pass into the generating tubes will not adhere to the walls of the tubes owing to their being set in a nearly vertical position, but peels off and drops to the bottom as soon as formed. Experience proved that the company's upright type, after being in constant work at full power for two years, shows less than 1-16 in. of scale on the tubes at any point, and even this small amount only in isolated patches, which, in their turn, fall to the bottom. This result is obtained without putting a scraper through the tubes at all, and without the necessity of drawing the water off, the tubes being simply brushed down from the top and the mud blown out through the bottom headers.



FRONT VIEW OF 390-HP UPRIGHT WATER-TUBE BOILER

It is claimed by the makers that absolute safety is secured, first, by the unexcelled circulation of the steam, which rises freely without encountering sharp bends or contracted connections, leaving the water always in contact with the hottest part of the tubes; by the absolute cleanliness of the interior of the tubes, which is maintained in the front sections immediately over the fire even after long periods of steaming; by making proper provision for easily and thoroughly inspecting the boiler at any time, at a minimum expenditure of time, money and trouble; by eliminating all flat surfaces and making every part of the boiler cylindrical and of great strength; by suspending the whole structure from the top, leaving it free to expand and contract independently of the brick-work setting and rigid frame work and foundation; by employing the best labor, materials and appliances.

The angle of inclination of the tubes, combined with their self-cleaning properties, insures the utilization of a very much greater proportion of the heat applied to them, thus conducing to great economy of fuel and thermal efficiency. Again, owing to the freedom from deposit in the generating sections, this water-tube boiler will maintain its maximum evaporative power and efficiency for long periods.

As a result of the design and the self-cleaning properties of the tubes, every foot of heating surface does its duty, and does it constantly, in practice, thus reducing the amount of heating surface required for a given evaporative duty. Owing to the angle of the tubes favoring the passage of the steam upward and inducing a strong circulation of steam and water, while the water is always in contact with the hottest part of the tubes, steam can be raised to working pressure at a very rapid rate, while in case of emergency, the Hornsby upright boiler can be forced to an almost unlimited extent.

The construction, in sections of about 3136 lbs. each, enables this boiler to be erected in the most inaccessible spots, while facilitating transport and saving freight, and the fact that it occupies small ground space makes it eminently suitable for central stations in large towns, where land is valuable.

In this boiler the steam mounts to the upper side of the tubes, and can thus rise unimpeded and without carrying over large bodies of water. In addition, on its passage from the front to the second row of headers, and so on to the steam drum, any moisture is gradually separated, and the steam at the stop valve is found to be exceptionally dry. The design and construction of the boiler reduce the possibility of priming to a minimum, and experience has shown that this boiler, even when forced to the extent of 20 per cent above its rated evaporative capacity, supplies steam containing less than 1.2 per cent of moisture, and at an ordinary average rate of working, the percentage of moisture in the steam is well below this figure. This point is recognized by engineers as of great importance, and for this reason it has been largely adopted by the more prominent manufacturers of turbines for their testing.

Where a superheater is required, it can be conveniently fitted to the upright boiler at low cost, or arranged alongside for separate firing, if considered preferable.

MAGANN STORAGE AIR BRAKES AGAIN AVAILABLE

The Magann Air Brake Company, Ltd., has been incorporated in Ontario, Canada, and has acquired all the assets, properties and patents of the old G. P. Magann Air Brake Company, of Detroit. The shareholders of the new company include well-known men in Toronto, of good financial standing and business reputation, who are able to provide ample capital for the development of the company's operations. Since starting business the new company has refitted the shops of the old company in Detroit, Mich., and materially increased the producing capacity. It has done a certain amount of business in the United States and Christchurch, New Zealand. Its main work, however, up to the present time has been in Canada, where it has a contract with the Toronto Railway Company for equipping some 330 of that company's cars with its storage air brake. This contract is now partially completed.

In addition to the Toronto Railway Company contract, some cars have been equipped for the Toronto & York Radial Company, which carries on a suburban business outside the Toronto city limits. The Magann Air Brake Company is at present negotiating for other contracts in different parts of Canada, and this year it will be in the field for further United States and other business. The system now being installed in Toronto is the same as that hitherto used by the old G. P. Magann Air Brake Company with one or two improvements.

The Western Ohio Railway and the Fort Wayne, Van Wert & Lima Traction Company have opened their new freight station in Lima. The two roads are preparing to operate four express and freight runs daily between Dayton and Fort Wayne.

TURBO-ALTERNATOR FOR GLASGOW

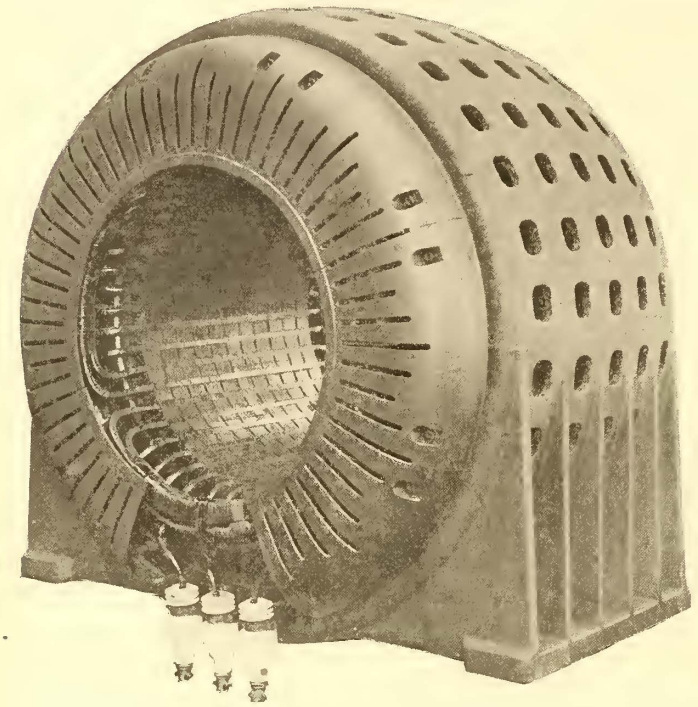
One of the most notable developments in dynamo machinery during the past few years has been their application to high-speed steam turbines. The conditions to be met call for a high degree of skill in design and considerable care in the manufacture. Though the electrical details of a high-speed machine necessarily demands close attention, the most serious problems are those of a mechanical nature; and this can be readily realized when it is mentioned that it is by no means uncommon to run the rotor of a 3000-kw turbo-unit at a speed of 1500 r. p. m. The accompanying engravings show the standard design of turbo-alternators adopted by Dick, Kerr & Company, of London. Among the most notable machines which this firm has completed or has under construction are the following:

Glasgow Corporation, two 3000-kw, three-phase, 6600 volts, 750 revolutions.

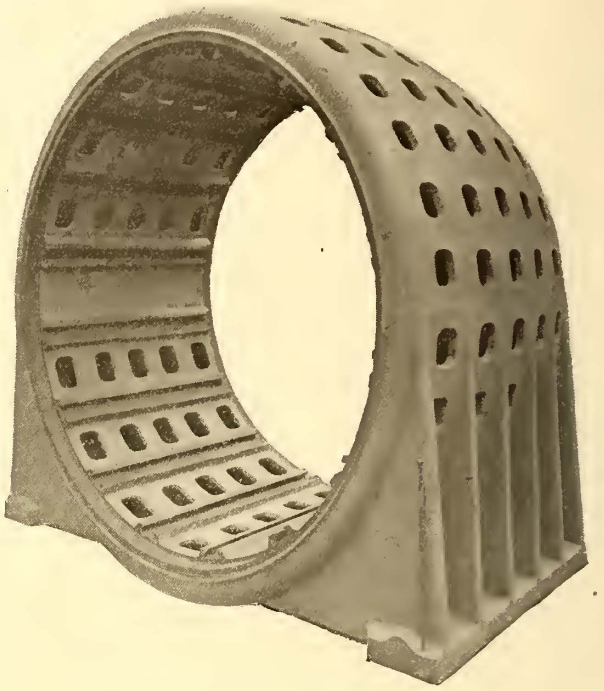
Bristol Corporation, two 1000-kw, three-phase, 6600 volts, 1500 revolutions.

Islington Borough Council, one 1500-kw, single-phase, 2500-2000 volts, 1500 revolutions.

Metropolitan Electric Supply Company, one 3000-kw, three-phase, 11,000 volts, 1500 revolutions.



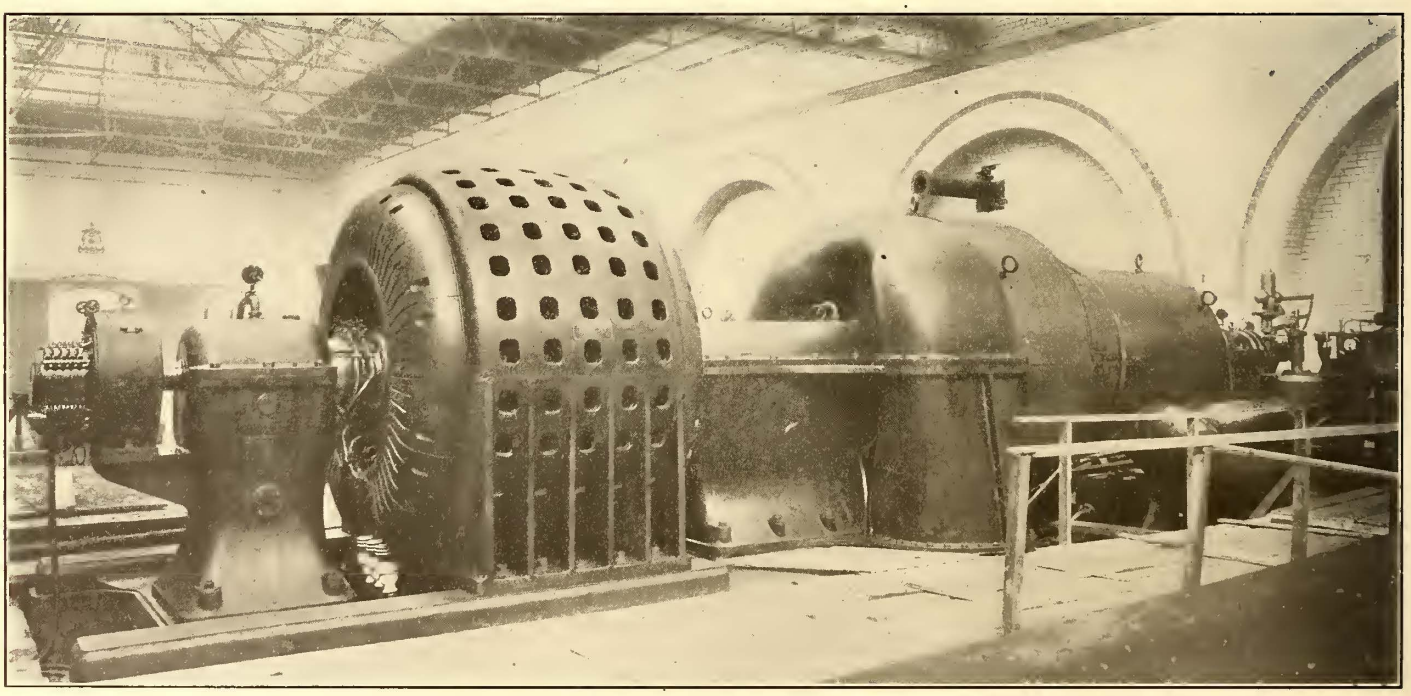
VIEW OF ALTERNATOR, SHOWING ARMATURE WINDINGS AND TERMINALS



FRAME OF GLASGOW ALTERNATOR

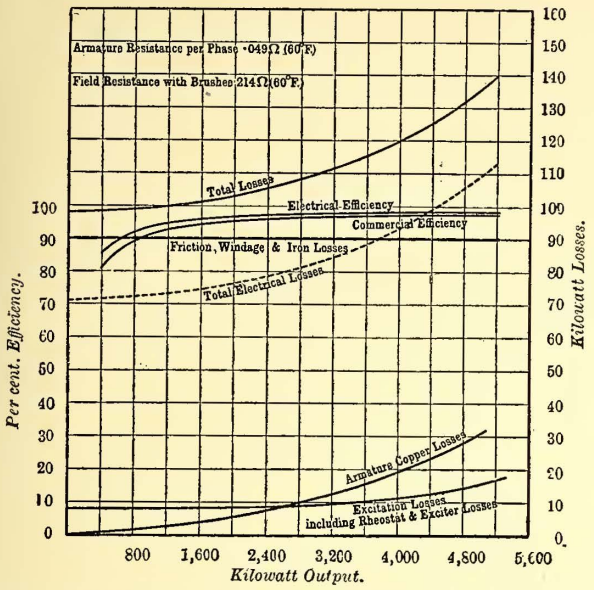
South Metropolitan Electric Supply Company, Ltd., one 1500-kw, two-phase, 3000 volts, 1500 revolutions.

The frame of the stator is made of strong cast iron, and supports the stator laminations. The winding is embedded in slots and insulated by means of pure mica. Special ventilating ducts are provided in the frame, and stiffening fingers clamped on the outside of the laminations obviate danger of vibration. The feet of the alternator frame are bolted to a special sole

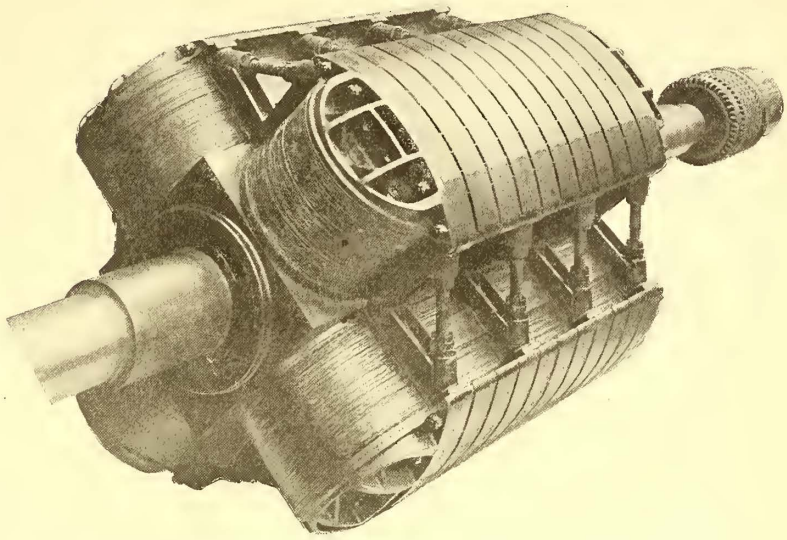


ONE OF THE 3000-KW TURBO-GENERATOR SETS INSTALLED FOR THE GLASGOW CORPORATION

plate, and the bed plate is such that it is possible to slide the stator in a direction parallel to the shaft so as to uncover the rotor for easy inspection. Perforated shields protect the outside windings against accidental contact or mechanical injury, and are furnished with open spaces for ventilation. The outside of the high-tension windings is covered with sufficient insulation for the full voltage.

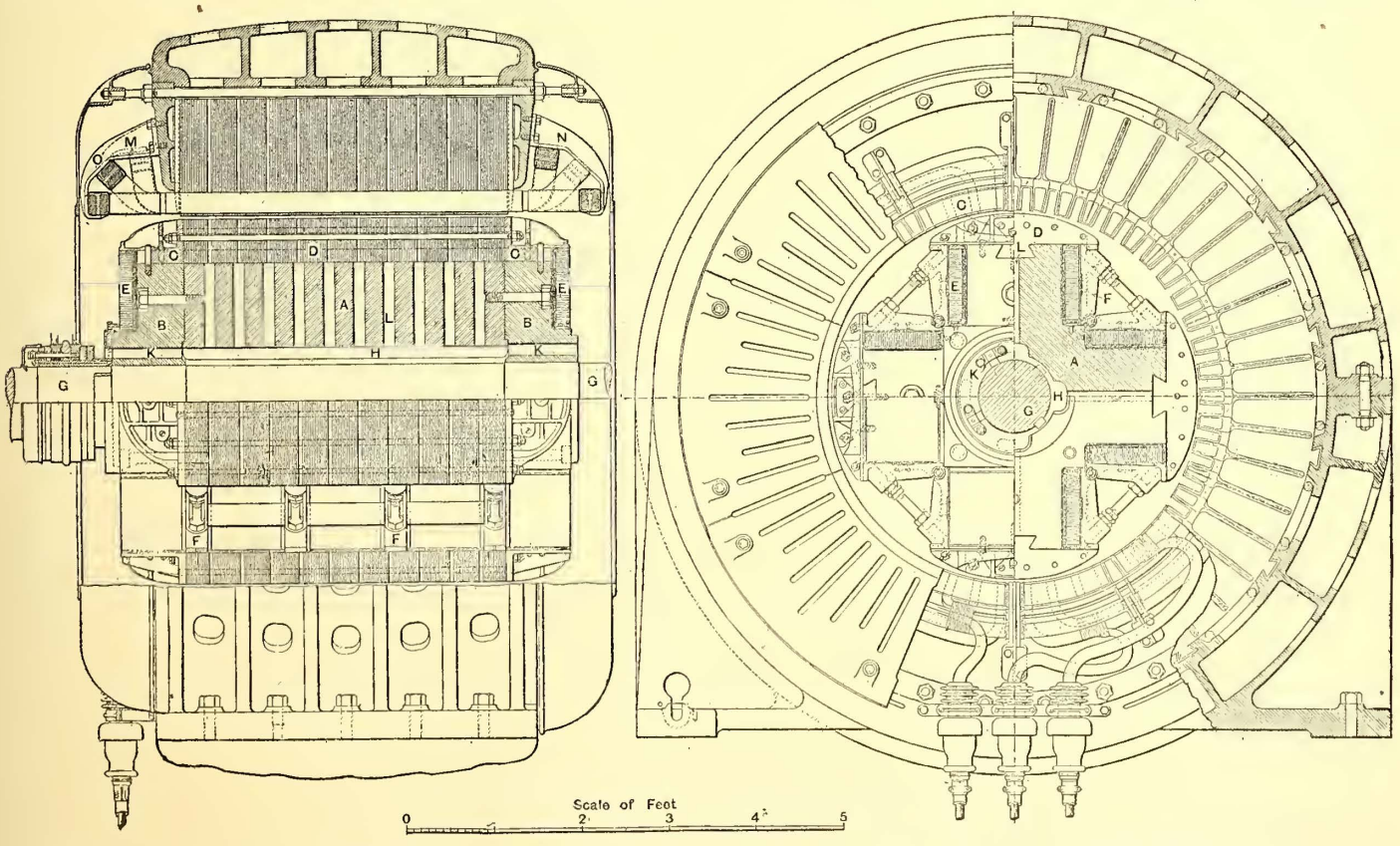


PERFORMANCE CURVES OF 3000-KW, FOUR-POLE GLASGOW TURBO-ALTERNATOR, OPERATING AT 6700 VOLTS, 25 CYCLES, 750 R. P. M.



VIEW SHOWING GENERAL ARRANGEMENT OF THE WINDING OF THE FOUR-POLE REVOLVING FIELD

The rotor body is built up of a central solid steel casting cast under pressure with four projecting poles. This central body, shown at *A* in the cut below, is machined and bored out to a diameter larger than the shaft. Two cross-shaped pieces *B* are built at each end of the central body, and carry the rotor on the shaft. These parts are so arranged in reference to the shaft as to leave an annular space all round for ventilation, the openings being shown at *K*. On the central body *A* radially drilled passages *L* are provided, which correspond to air ducts in the laminated pole tips, these being in line with openings left in the stator iron. The pole tips are laminated and are dovetailed on the steel casting of the central body. Special end pieces, shown at *C*, also dovetailed on the steel casting, retain the laminated tips in position and at the same time act as checks against centrifugal force to keep the spools in position. The dovetails on the central body *A* and on the end pieces *B* are of such a dimension as to allow the steel tips *C* to be put into position by sliding in on the dovetail of the central body *A*. It will be seen that when the laminated pole tips have been inserted in position and pressed together by means of the steel tips *C*, they are interlocked and cannot shift. To guard against centrifugal force which would tend to spread the field coils, laterally wedged pieces *F* are inserted between ad-



CROSS AND SIDE SECTIONS OF THE ELECTRICAL END OF THE GLASGOW TURBO-ALTERNATOR

jacent coils passing against them and the laminated pole tips.

The field winding is built up of solid copper strip wound on edge, insulated between turns by means of paper and mica, and supported in a special copper spool with heavy insulated flanges. The spools, after being formed and insulated, are subjected to hydraulic pressure in the axial direction of about 50 per cent over the pressure to which they would be subjected from centrifugal action in normal running. The copper winding of the fields bears flat on the insulation, thus avoiding any danger of cutting. The terminal leads of each spool are carried out on the bottom of the spool, and are composed of very thin and flexible copper strips. Between the spools special wedges, already indicated at *F*, are provided against the horizontal component of the centrifugal force, which tends to open the spools. The spools, after being assembled and connected up, are finished on the outside surface, where otherwise the copper would be bare, by means of a special varnish, which is oil and waterproof, and presents a very hard and glossy surface, making it easier to clean the machine. The shaft is a special pressed steel and finished all over, and the rotor is pressed over it with about 100 tons pressure.

The collector rings are of manganese bronze, fixed over a solid steel sleeve, and of special construction as to make it impossible to be subject to deformation under working conditions; the collector rings are shrunk hot over special micanite rings, which are built up directly on the steel shell of the collector ring. The leads from the field coils are carried to the collector rings and are protected by means of special metallic caps which are fitted over the shaft and to the end of the rotor body. The connection of the leads to the collector rings is also protected by a special cap, which is easily removable for inspection if necessary. The finished appearance of the collector rings and rotor body is such as not to have any loose connection or projecting part, making it possible to keep the machine clean when running.

The brushes are of special graphite copper of very low friction co-efficient and high conductivity, and those belonging to one collector ring are kept separate from those belonging to the other. Ample contact is provided on the brushes, and they may be adjusted and replaced if necessary when the machine is running, without interfering with its working.

The exciter is usually designed to give its full load continuously, with a rise in temperature not exceeding 65 degs. F. above the surrounding atmosphere. The exciter is connected to the alternator shaft by means of a flexible coupling on one side, while the other side of the shaft is supported by a spherical bearing provided with oil rings. An efficiency curve of the 3000-kw machine is also given herewith.

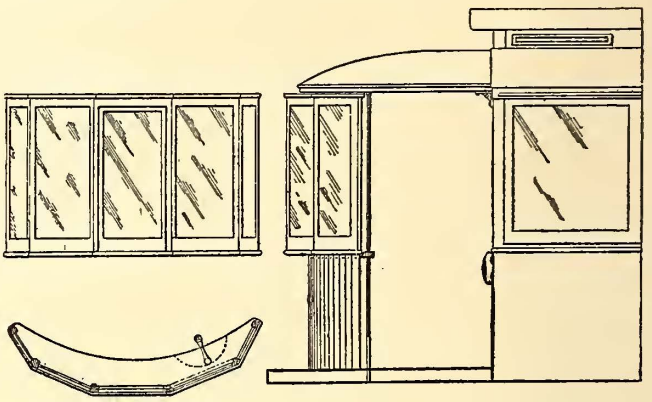
The engravings of the complete unit at Glasgow show the alternator direct connected to a Parsons turbine, manufactured by Willans & Robinson.

THE ILLINI TRAIL

"The Illini Trail" is the title of a recent publication issued by the Illinois Valley Railway Company. When Marquette and Joliet passed through Illinois, the Illini tribe of Indians inhabited the valley now traversed by the railway company, and it was from this source that the name of the pamphlet was derived. The booklet is descriptive of the picturesque valley and the country reached by the traction line. Quite a little space is devoted to weaving an atmosphere of romance about the points of interest along the river by recalling the experiences of Marquette, LaSalle, Tounty and other early explorers in traversing the region. The places where the best hunting, fishing and boating are to be had are pointed out, and in general the matter of the pamphlet is such as to excite the curiosity of the casual reader, producing an incentive to take a trip over the line and causing him to enjoy it the more when he does do so.

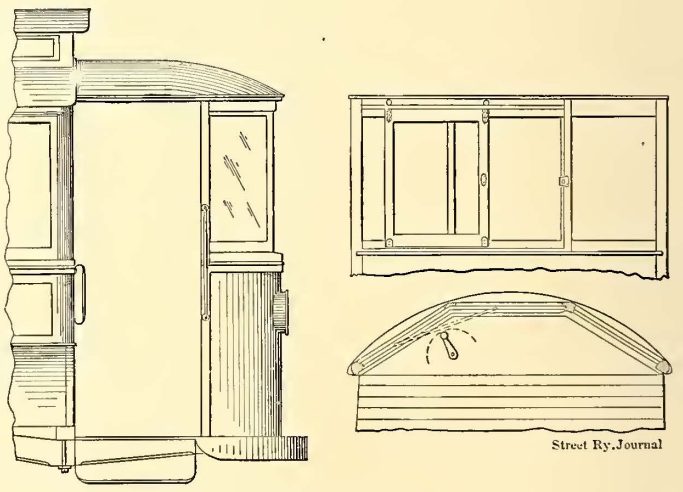
NEW STYLE OF VESTIBULE WITH SLIDING SASH

In connection with the problem of vestibuling closed city cars for the protection of motormen and conductors from bad weather, J. F. Sjoberg & Company, of New York, have recently devised several important improvements which they are now incorporating in both their three-light and five-light vestibules. Instead of hinging the center sash, as has been the practice heretofore, it is mounted on an angular steel track overhead. The degree of curvature of this track is a matter of no consequence, as the sash is provided with swivel sheaves, which



PORTABLE VESTIBULE, WITH SLIDING SASH IN CENTER

adapt themselves to the curvature of the track, while the sash moves diagonally across the angle. The sash is further guided at the bottom in each corner by plates, with rollers running between guide strips, permitting the sash to operate freely above these guide strips. When closed, the sash is held in position by a sash fastening, which also serves as a handle to operate the sash. The side lights are fastened directly into the stanchions or frame of the vestibule. Narrow wooden or brass



NEW STYLE OF VESTIBULE USING ANGULAR STEEL TRACK OVERHEAD

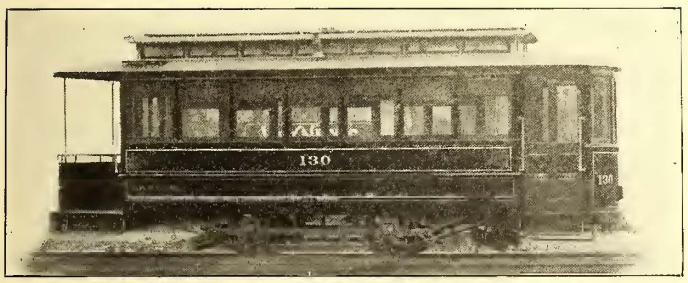
channel stiles may be employed in constructing the center sash, thereby minimizing the obstruction to the motorman's view by using the least amount of opaque material. The so-called portable vestibules are usually made to project a few inches over the dash to allow the free swinging of the controller and brake handles.

Among the advantages claimed for the sliding sash over the usual type of sash which is dropped into a pocket are the following: As the side sashes are not required it is unnecessary to route or groove any pillars for their reception; no pockets involving expensive panel work on the inside of the vestibule are required, and consequently interference is avoided with the headlight, brake and controller stands or other mechanism required at the front end of the car.

The manufacturers of this form of vestibule recently furnished 200 five-light vestibules to the Coney Island & Brooklyn Railroad Company, and 610 three-light vestibules with ¼-in. polished plate glass and brass stiles to the Brooklyn Rapid Transit Company. The latter company has also awarded to J. F. Sjoberg & Company an additional contract for the vestibuling of over 1300 cars, which are practically the balance of the Brooklyn Rapid Transit Company's closed cars. The same company has also adopted the sliding sash for the stationary vestibules on such of its standard closed cars as are now under construction.

CLOSED CARS FOR JOHNSTOWN, PA.

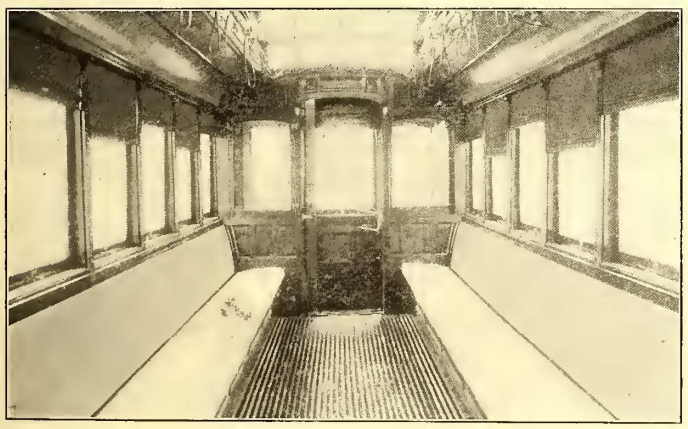
The Johnstown (Pa.) Passenger Railway Company has lately added to its equipment six closed cars built by the G. C. Kuhlman Car Company. Besides serving the City of Johnstown, with its 40,000 population and populous environs, the railway system includes an interurban line to Windber. The system includes 33 miles of track and seventy-five cars are



SINGLE-TRUCK CLOSED CAR FOR JOHNSTOWN, PA.

operated. The large double-truck cars used were built by the John Stephenson Company. As the cars run in one direction only, the entrances at both ends are on the one side. The forward platform is vestibuled and the rear open. The interior of the cars is handsomely finished in mahogany with birch ceilings. The longitudinal seats are upholstered in spring cane and the seat fronts are paneled in mahogany.

The length of the cars over the end panels is 20 ft., and over the crown pieces, 29 ft.; the width over the sills, including the



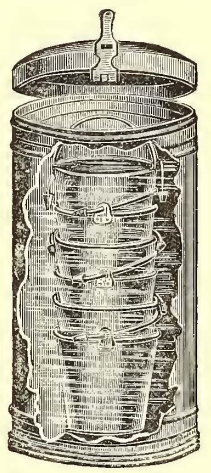
INTERIOR OF JOHNSTOWN CAR

sill plates, is 6 ft. 10¾ ins., and over the posts at the belt, 7 ft. 10 ins.; the sweep of the posts is 5⅝ ins.; the distance between the centers of the posts is 2 ft. 9⅝ ins.; the height from the floor to the ceiling is 8 ft. ⅝ in.; from the track to the under side of the sills, 2 ft. 2¾ ins., and from the under side of the sills over the trolley board, 9 ft. ⅝ in.; from the track to the platform step, 14½ ins.; from the step to the platform, 12 ins., and from the platform to the car floor, 6⅜ ins. The side sills are 4⅛ ins. x 8¼ ins.; end sills, 4¾ ins. x 7¾ ins.; sill plates, 7½ ins. x ½ in.; the thickness of the corner posts is 3⅝ ins., and of the side posts, 2¼ ins. The cars are mounted on Brill No. 21-E trucks, with 7-ft. wheel base, 33-in. wheels and 4-in. axles.

THE SAFETY BUCKET FIRE TANK

Whoever has had some experience with the old-fashioned fire pails and water barrels must welcome the great improvement brought about by the wide introduction of the safety bucket fire tank and enclosed pails, made by the Safety Fire Extinguisher Company, of New York. This tank, which stores the pails vertically by nesting, makes it unnecessary to waste valuable floor space or to suffer the nuisance and danger arising from the presence of open pails and water barrels filled with stagnant water, or, still worse, not filled at all when needed.

The safety fire bucket tank and buckets are made of heavy galvanized iron and lined to prevent corrosion and rust. The tanks are japanned red on the outside, and have a hinged cover which closes down on a rubber packing, so as to make the tank air-tight, thus preventing evaporation.



LIQUID-FILLED FIRE TANK WITH NESTOR BUCKETS

The handles of the buckets are so weighted that when the top bucket is removed the handle of the next rises automatically and fills. Each bucket has two lugs on the outside, hence when the buckets are placed in the tank, one inside of the other, they rest on the lugs, and consequently cannot bind or stick.

Every tank is accompanied by a bag of a special compound put up in powder form, with full directions for using. This powder, when dissolved in water, forms the fire-quenching solution with which the tank is filled. This solution, upon coming in contact with fire, immediately forms a gas which has a fire-destroying capacity equal to many times the same quantity of water.

Where the tanks are to be used in exposed places, a compound is furnished that will not freeze in a temperature as low as 20 degs. under zero. The solution contains no acid and is harmless; it does not lose its efficiency with age. When the six buckets have been removed, there is enough solution left in the tank to refill four of the buckets.

The tank, being ornamental and compact in construction, can be put in any convenient or conspicuous place, where it will be sure to be seen and used in case of fire.

PROGRESS ON THE NEW YORK, NEW HAVEN & HARTFORD LOCOMOTIVES

During the past week the first of the twenty-five Westinghouse single-phase electric locomotives ordered by the New York, New Haven & Hartford Railroad for operation on its lines between Woodland and the Grand Central Station in New York City, was received from the Baldwin Locomotive Works, Philadelphia, by the Westinghouse Electric & Manufacturing Company at its works at East Pittsburg. The Baldwin Company, working jointly with the Westinghouse Company, constructs the locomotives and the Westinghouse company provides the electrical equipments. Each locomotive is to be equipped with four Westinghouse single-phase railway motors of the straight series gearless type, and also with the unit switch system of multiple control. It is expected that this first locomotive will be ready to run by the middle of January.

THE PREVENTION OF DUST ON ELECTRIC RAILWAYS

The interest of street railway managers in laying dust on roadways is second only to that of those who have in charge the maintenance of streets and highways. Many companies operating along suburban roads have recognized the importance of preventing dust raised by the passage of cars to the extent of voluntarily sprinkling the right of way. The dust question is important, not only from the standpoint of residents along the right of way, but because of the detrimental influence that dust has on the operating expenses in the way of cost of maintenance of journals and motors, as well as on the like detrimental influence on the gross receipts from passengers who ride for pleasure. Dust is usually the worst in summer, when pleasure riding traffic should be the best. Many electric railway managers, especially those operating over long, suburban or interurban stretches of track, would be glad if something could be found more permanent in its dust-laying effects than water. Not only is it desirable to keep down the dust because of its detrimental effects on lungs, clothing and rolling stock, but the life of the pavement is to a certain extent dependent on how well its surface is bound together, and wherever there is dust on macadam pavement, it is good evidence that the pavement is being destroyed at an abnormal rate. As street railway companies are in many cases responsible for the maintenance of the pavement along their tracks, this point is also of interest to them, since it is to their interest to decrease as much as possible the cost of maintenance and repairs of pavement.

The plan of using water for sprinkling and laying dust leaves much to be desired. Where long stretches of roads on which there is light traffic must be covered, the cost of sprinkling by water frequently may be prohibitive. The dust is laid by the water for only a few hours. Immediately after sprinkling, mud is formed, which is undesirable, both because it may necessitate the use of sand on the tracks and because the mud is secondary only to dust as a general nuisance. Crude oil has been used to some extent as a substitute for water in laying dust, its advantage being that it need be applied only at infrequent intervals. It is not altogether desirable because of its odor and the fact that when fresh the oily dirt from the street is tracked into cars, offices and houses, and further, it renders a street slippery.

Attention has recently been brought in this country to a new solution for street sprinkling purposes called "Westrumite." Although new in this country, it has long since passed the experimental stage in Germany, where it has heretofore been manufactured. The effect of sprinkling with this solution is to bind the material of the roadway together, forming a kind of waterproof surface. The best results are obtained by using Westrumite during the making of a macadam road. Since it acts as a binder, its application at the time the road is made should, of course, make it more effective than sprinkling with it after the road is finished. Nevertheless, some remarkable results are obtained simply by using it as a sprinkling solution. Westrumite is a chemical compound soluble in water. It is mixed up to the strength of a 4 per cent or 5 per cent solution in the ordinary sprinkling cart or car. It is claimed that the periodical application of the compound every eight to twenty days will make any street paved with macadam, granite, brick or wood permanently dustless as far as any dust due to the material of the street is concerned. Asphalt must be treated in a special manner and can only be washed with a weak solution of about 2 per cent once every two days. The cost of the application of Westrumite is almost entirely counterbalanced by the saving in labor, as against sprinkling with water five times per day in the summer, or from 40 to 160 times to each single time that the Westrumite would be applied. Even such frequent sprinkling with water will not give an absolutely dustless street, as it has no permanent binding power on the pavement, and dust will fly as soon as the water is evaporated from the surface. Westrumite dries in one-half to three hours, varying with the temperature, and after it is dry holds down the loose material in the road. One desirable peculiarity is that it is not washed away by heavy rainfall. After a street has been sprinkled with it so that the surface is well bound together, additional sprinklings do not cause the annoying mud that accompanies sprinkling with water.

Some very careful experiments have been carried on by the South Park Commissioners of the city of Chicago. The commission has for some time been treating with Westrumite 2 miles of the Midway Drive connecting Washington and Jackson Parks. A 3½ per cent solution has been used with sprinklings every eight to fourteen days. The result of such treatment is that the macadam paving has the aspect of an asphalt street, and even the worst automobile scorcher cannot raise a dust in passing over it, so firmly is the surface knitted together. Some of the paths in a park have been treated in a similar manner.

A company has recently been formed in Chicago headed by L. E. Myers, T. P. Bailey and other prominent business men of that city, some of whom are well known in electric railway circles. The company is erecting a factory for the manufacture of Westrumite at Whiting, Ind., so that this material will in a short time be available on the American market. The trials that have been made with it so far in this country have been with material imported from Germany.

THE NEW CARS OF THE CLEVELAND & SOUTHWESTERN TRACTION COMPANY

At present, when electric railway associations over the country are devoting so much time to the proper design of interurban cars, it is of interest to note some of the features of a new car built by the St. Louis Car Company for the Cleveland & Southwestern Traction Company. This type of car, of which ten were constructed by the St. Louis Car Company and five by the Niles Car & Manufacturing Company, was illustrated in the Street Railway Journal of Dec. 16, 1905.

These cars are intended to be operated in one direction only. This has permitted the front of each car to be constructed without the usual drop platform, and the added strength of a platform built on the same level with the floor has been attained. The front of the car is circular, which form gives less head resistance.

The principal dimensions of the car are: Length over all, 51 ft.; width over all, 8 ft. 7 ins.; height from the under side of the sill to the top of the roof, 9 ft. 6½ ins. The inside lengths of the passenger, smoking and baggage compartments, into which the interior of the car is divided, are respectively 22 ft. 10 ins., 11 ft. 2½ ins. and 10 ft. 5¼ ins. The floor framing is the St. Louis Car Company's standard for interurban cars, all the longitudinal sills being of yellow pine, while the end and cross sills are of oak. The side sills, measuring 5 ins. x 8 ins., are each reinforced with a 6-in. steel channel running the full length. The center sills are of 6-in. I-beams sandwiched in between yellow pine fillers, while the intermediate sills are of yellow pine, 4½ ins. x 6 ins. in cross section. Heavy steel plates extending the full length of the car back of the letter boards and connected with steel angles and channels in the corner posts of both the front and rear end of the car reinforce the side frames. A combination Gothic sash extends over two of the lower side sash, this latter being arranged to raise. The Gothic sash are made with oval tops, being glazed with green opalescent glass. The deck sash are constructed in three sections, the center section being arranged to swing, while the remaining ones are stationary. The interior of the car is fin-

ished mahogany, any undue plainness being relieved by marquetry. Empire ceilings decorated in gold give a lofty appearance to the interior of the car.

The car contains twenty-one stationary seats, covered with green plush and fitted with high back head rolls. The seats are also provided with arm-rests of mahogany and stationary foot-rests. In addition to six stationary seats, the smoking compartment contains a sofa placed against one of the partitions. The car is heated with hot water, the heater being located in the baggage compartment near the partition between this compartment and the smoking room. To prevent baggage from falling over against the motorman and the control apparatus, the front of the forward compartment is provided with a heavy pipe guard. The trucks employed are the St. Louis Car Company's M. C. B. type No. 61, these being machine finished throughout. Rolled-steel wheels are employed, and the St. Louis Car Company's spiral journal bearings are used.

WOOD BLOCKS FOR TRACK PAVING

The problem of paving between street car tracks has been a troublesome one for a number of years, especially in cities like New York, where this work is done at the expense of the railway company instead of the municipal authorities. The problem is especially vexing where a smooth pavement is required.

MAIN STREET, SPRINGFIELD, MASS., PAVED WITH WOOD BLOCKS

Asphalt, which is the commonest of the smooth pavements, is not suited to track work, because the oil drippings from cars dissolve the bitumen and ruin the pavement. Asphalt is also incapable of withstanding the vibration of tracks and ties.

Probably the simplest solution of the problem in found in using wood blocks such as those made by the U. S. Wood Preserving Company, of New York. This pavement is of marvelous endurance. It is easily laid without skilled labor or special appliances, and can be readily removed for repairs to track and electric connections. The simplicity of splitting the blocks with a hatchet, when required, makes it an easy matter to fit the pavement closely in the odd shaped spaces between crossings and switches.

THE TOLEDO & CHICAGO SINGLE-PHASE INTERURBAN RAILWAY

A prominent addition to the interurban field of the Middle West is the Toledo & Chicago Interurban Railway Company, which traverses a well populated section of country in the northeastern part of Indiana. The lines when completed will extend for a distance of about 150 miles, from Goshen, Ind., on the west, where connection is made with the lines of the Indiana Electric Railway Company, to Alvordton, Ohio, on the east. The southern branch from the main line at Garrett extends to Fort Wayne, where it connects with the Fort Wayne & Southwestern Traction Company, the Fort Wayne, Van Wert & Lima Traction Company and other lines converging at this point. The line thus forms a connecting link for the systems of interurban roads extending eastward from Chicago and northward from Indianapolis, and for those connecting Cleveland, Toledo and Detroit and extending westward from Toledo, Ohio.

At the present time 50 miles of road are constructed, extending from Fort Wayne 18 miles north to Garrett, and from there northeast 20 miles through Auburn and Waterloo to Butler, and northwest 12 miles through Avilla to Kendallville, where the power station is located. The extensive character of the total installation when completed, and the fact that high speed, necessitating heavy equipment, can be maintained on the private right of way, rendered advisable the equipment with the General Electric Company's alternating-current single-phase railway system.

The power house at Kendallville is on a good-sized lake, where plenty of condensing water is available. Two 800-kw, 25-cycle Curtis turbine generators with necessary auxiliary apparatus, switchboards, etc., constitute the present central-station equipment. Power will be supplied to the trolley at 3300 volts at the power house, while sub-stations will receive 33,000 volts from transmission lines supplied by step-up transformers in the power house. Each sub-station equipment consists of two 200-kw, 33,000-3300-volt, single-phase step-down transformers, with the necessary switches, meters and lightning arresters.

For the rolling equipment for the 50 miles, ten four-motor General Electric 75-hp single-phase alternating-current compensated type equipments are required, operating eight passenger and two package freight cars. These equipments are suitable for operation on 3300 volts alternating and 600 volts direct current, and are controlled by a cylinder controller serving both for a. c. and d. c. operation. For a. c. operation the controller gives a potential control, varying the voltage applied to the motors, making every point a running point. For d. c. operation the control will be rheostatic. The change form a. c. to d. c. control is made by a commutating switch operated by the reverse handle. The main power circuit is closed by two main switches, one for a. c. and the other for d. c. operation, so interlocked that they cannot be closed together, and so arranged that either one will open automatically if closed by mistake upon the wrong circuit. Each car equipment is furnished with a trolley, air compressor and air brake. The air compressor is driven by a compensated motor operating on both a. c. and d. c. current. The line equipment is 000 catenary construction trolley and three No. 2 copper high-tension line. The rails are 70-lb. A. S. C. E. section. The first cars put in service will run on local service from Waterloo to Kendallville as soon as the northern end of the line is ballasted sufficiently.

SOME INTERESTING RAILWAY SPECIALTIES

A point often overlooked in the construction of tools and other appliances for work in the field is that such tools are usually put into the hands of laborers rather than mechanics, and are consequently subjected to very rough usage. The working parts of such a tool should be covered and protected as well as possible, and the machine itself should be built with lines of strength at every point. That these facts have been appreciated in the design of the drill and tool grinder made by Cook's Railway Appliance Co., of Kalamazoo, Mich., may be seen from the accompanying illustration, Fig. 1, showing the tool grinder mounted on an iron column.

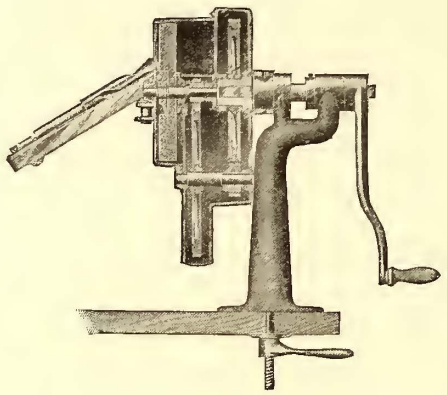


FIG. 1.—TOOL GRINDER MOUNTED ON IRON COLUMN

The tool grinder is intended primarily for field work, being built so that it can be readily attached to the top frame of the company's standard rail drill by removing the crank handle, or it may be used on a malleable-iron column, both of which are interchangeable with the grinder. The emery wheel of the grinder, it may be observed, is driven through two intermediate gears by a crank. These gears, as well as the emery wheel itself, are encased in a malleable-iron shell, which practically insures freedom from injury in the hands of that class of workmen usually employed on track work. The emery wheel is separately encased from the gears, thus avoiding the wearing and grinding effects on the gears resulting from the flying emery dust.

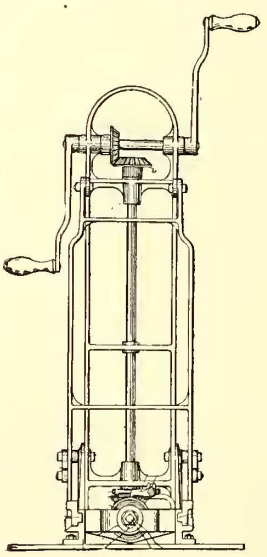


FIG. 2.—RAIL DRILL APPLIED

An opening in the disc covering the emery wheel provides for the insertion of the drill to be ground. This is carried in a holding device fitting a socket cast with the disc. By means of an adjusting screw, the drill-bit can be held in exactly the same position with reference to the face of the emery wheel while both lips are being ground, so that a symmetrical cutting edge and the necessary clearance is always obtained. When the bit has once been adjusted to position in the holder, the grinding operation consists simply in swinging the bit-holding device backward and forward. Should it be desired to use the edge of the emery wheel for grinding other tools, the top half of the cover, which is provided with hinges, may be swung back.

The emery wheel, which is 6 ins. in diameter and 1 in. thick, is geared to a ratio of thirty-six revolutions to one turn of the crank. The high-speed journals run in brass bushings, the internal bearings being oiled through tubes extending outside of the enclosing shell.

A feature of the Cook standard rail drill is that it is collapsible and can be readily folded to a convenient form for carrying it to different places.

Another feature of much importance besides the variable and reversible feed is that the thrust of the drill-bit holder is taken by a ball bearing, which reduces the friction, and consequently increases the ease of operation. The balls in this bearings are well protected by dustproof caps. It is a great convenience in track drills to be able to change feeds without stopping the drill. The Cook standard drill provides for this, so that it is possible to employ a fast feed until the point of the drill has penetrated to a depth where a slower speed is necessary, when the feed can be diminished. Tests have shown that a 7/8-in. hole can be drilled in 2 minutes and 8 seconds through an 80-lb. T-rail. The same can be done in 2 minutes with ease.

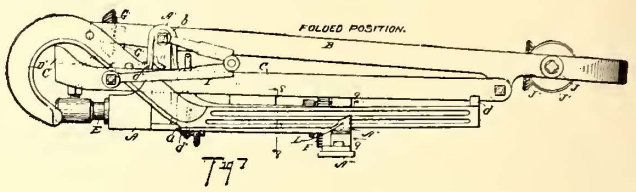
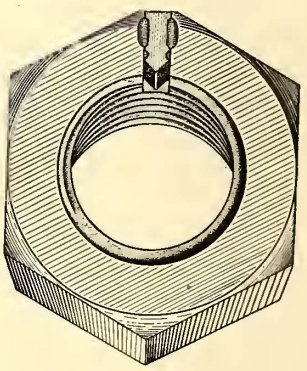


FIG. 3.—DRILL IN FOLDED POSITION

The automatic lowering and track jacks put on the market by this company have many features to recommend them to those in the street railway field. The automatic lowering jack is especially adapted to the many uses to which such a tool is put about a car repair shop. The Cook steel cattle guard is also one of this company's productions, besides a combination wood-steel cattle guard, which seems to be greatly appreciated by the users of such devices.

A NEW LOCK NUT

The accompanying illustration shows the new Burrows lock nut which is being introduced by the American Lock Nut Company, of Boston, Mass., for use wherever a simple and practical device is wanted for the rigid locking of nuts under all conditions. Its mechanical principle is the right angle contact of two cutting edges. In construction it is a rocking key set in a slot in the upper surface of the nut and intersecting the bore of the nut at right angles. In service, the cutting edge of this hardened key engages the softer threads of the bolts, with the result that the nut is held rigidly in place.



NEW LOCK NUT

From the illustration and description given, it is plain that this lock nut is not of intricate or expensive construction, and can be locked and unlocked an indefinite number of times without impairment. To assemble, the nut is unlocked by driving down the outer end of the key until the other end clears the thread, allowing the nut to pass freely on the bolt. When the nut is thoroughly seated, it is locked by driving down the end of the key next to the bolt.

CONDUCTIVITY OF RAILS AS AFFECTED BY COMPOSITION

S. S. Wales contributes an article in a recent issue of the "Rose Technic" on "The Electrical Conductivity of Steel as Affected by Chemical Composition and Physical Treatment." His conclusions are that of the common impurities found in steel, manganese has the most powerful effect in increasing the resistance, also that annealing and tempering on the very soft specimens is of practically no value. On the higher carbon samples, the effect of water hardening on the resistance is quite marked, but the annealing appears to return the steel to its former condition electrically, and nearly so physically.

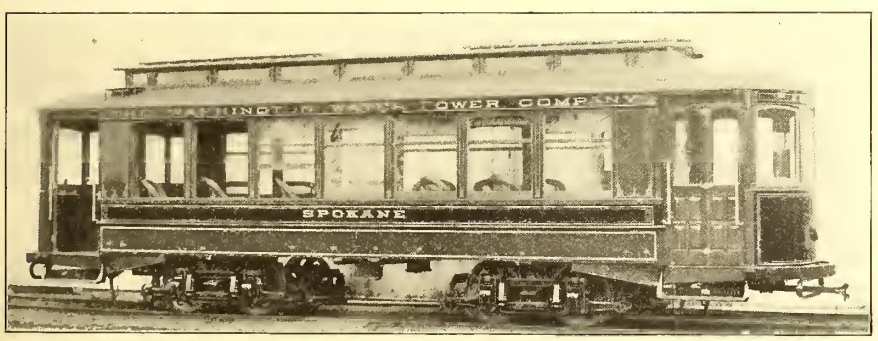
THE QUESTION OF CROSSING STOPS IN LOS ANGELES

By way of providing greater safety to the public, Superintendent Akin, of the Los Angeles Railway Company, issued a bulletin on Monday, Dec. 11, to the effect that on and after that date all the company's cars not having the right of way will come to a full stop at track crossings and where tracks intersect. These cars must stop at least 10 ft. from the nearest cross track. Cars having the right of way must proceed over crossings with the power thrown off, and at not more than 3 m.p.h., under complete control of the motorman, and with the gong ringing continuously. Under the old rules motormen were ordered to have their cars under complete control, and although an excellent system of right of way was devised, the management is of the opinion that the motormen thereunder were allowed too much discretionary power. While this order will lower the time possible between terminals, the officials feel that the increased safety of the passengers will offset the inconvenience resulting. The Los Angeles-Pacific Railroad is in favor of even greater changes. President E. P. Clark would like to have the other companies agree to stop all cars for passengers, either boarding or alighting therefrom, before reaching the crossing, instead of on the other side of the crossing. Superintendent Akin, of the Los Angeles Railway Company, has not approved the idea. He does not question the value of the plan as a safety proposition, but is of the opinion that it would take too long to educate the public to the change.

SEMI-CONVERTIBLE PARLOR CAR FOR THE WASHINGTON WATER POWER COMPANY

The handsome parlor car which is shown in the accompanying illustrations has just been shipped to the Washington Water Power Company by the J. G. Brill Company. It is for the use of the officers and directors of the railway, and will be rented also to private parties for excursion purposes.

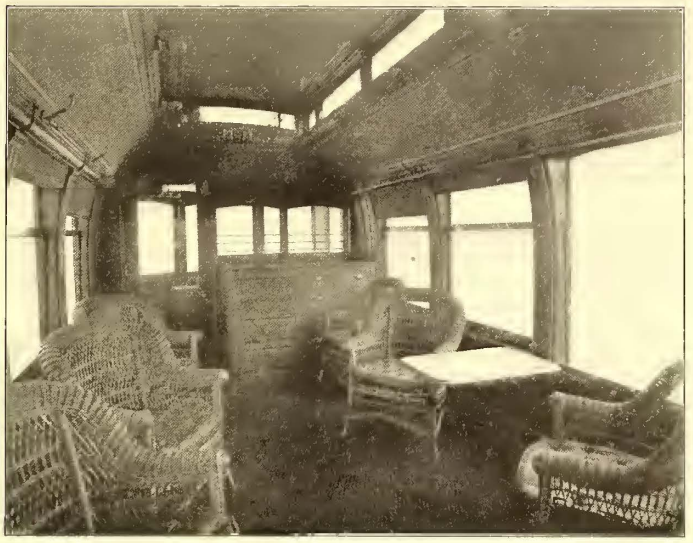
Spokane has a population of 40,000 and is the principal railway center of the State. The suburbs are extensive and include a large number of populous towns. The city is noted for its fine streets and buildings, and the scenery in the neighborhood, which may be seen from the lines of the railway company, is unusually interesting. The company has a trackage



DOUBLE-TRUCK PARLOR CAR USED IN SPOKANE AND VICINITY

of about 75 miles and has nearly 100 cars in operation. It owns Natatorium Park and furnishes power to the Coeur d'Alene mines, which are 100 miles from Spokane. The Brill Company has furnished a large part of the rolling stock of the Washington Water Power Company; five lots of cars were of its convertible type, and the last lot of ten cars, semi-convertibles. A lot of twenty semi-convertibles of the grooveless post type, measuring 30 ft. 8 ins. over the bodies, is being built at present.

As may be seen from the view of the interior of this car, there has been very little attempt at ornamentation. The woodwork is of quartered oak in its natural color, rubbed to a dull finish. A commodious closet at one corner of the car has a refrigerator in the lower part, with the compartments conveniently arranged. A narrow closet with hinged cover at the top, is placed back of the door in the corner at each end of the car to store the tables when not in use. The wicker chairs are stained the same color as the woodwork and have leather cushions. A seat accommodating three passengers is built



AN INTERIOR VIEW OF PART OF THE SPOKANE PARLOR CAR

against the end of the car opposite to that shown in the illustration of the interior. The backs and cushions are comfortably upholstered in leather, and it has the appearance of a lounge. The floor is of hard wood and covered with a carpet rug. Light-green buckram covers the birch veneer head linings, and is striped and decorated with gold. The entire effect is very pleasing, particularly because the car is lighted by extra large windows, the centers of the posts being 3 ft. 6 ins.

It will be seen that the window system is the Brill grooveless post, semi-convertible type, and the car is the first to have all the windows of this large size. Semi-convertible cars, which the builders furnished to the Boston & Worcester Railway a year ago, had two large windows at each end, but the rest of the windows were of the ordinary width, namely, 2 ft. 8 ins. from center to center of posts. As the platforms will be used for observation purposes, they are made 5 ft. long. The doors in the body ends, as will be seen in the view of the interior, are single and swing inwardly. The car is equipped with four "Dumpit" sand boxes, which are placed under the platforms, with small, neat cover-plates set into the flooring of the platforms. The horizontal brake wheels, channel-iron draw bars, angle-iron bumpers, platform gongs, signal bells and other specialties are of the builder's manufacture. The car measures 28 ft. over the body and 29 ft. over the vestibules; width over sills, 8 ft. 2½ ins., and over the posts at the belt, 8 ft. 6 ins. It is mounted on No. 27-F trucks, with one 40-hp motor per truck.

Manager E. S. Dimmock, of the Canton-Akron system, has arranged for the sale of theater tickets for attractions at Canton, at various points along his line. Each theater ticket contains coupons good for transportation to and from Canton. By this plan the company is enabled to provide plenty of cars and furnish a seat to every passenger to and from the show. The first night the excursions were instituted the company carried 400 people from Massillon and 200 from Akron to Canton.

LONDON LETTER

(From Our Own Correspondent.)

Last month reference was made to the fact that the city of Lincoln would soon be equipped with a system of tramways, and that special interest attached to this system on account of the fact that it would use the Griffiths-Bedell surface contact system. After being examined by the inspectors of the Board of Trade, who granted the Corporation permission to put it in operation, the system was formally inaugurated, the Mayor and the chairman of the electricity works committee and other officials of the Corporation being present at the ceremony. After the trip the members of the Corporation were received at the Saracen's Head Hotel by Mr. Griffiths and Mr. Bedell, who were both extremely pleased with the results. The length of the new line, at present, is about 2 miles, and the contract has been carried out by Griffiths & Company, of London. The eight cars, which are at present in service, were constructed by the Brush Electrical Engineering Company.

It is a pleasure to be able to report that the great task of electrifying the Metropolitan District Railway has at last been completed. There are now in the tunnels of the Metropolitan District Railway no steam-drawn trains. The progress of this system has been reported in these columns from time to time, so that it will be remembered that the whole electrification scheme was practically completed some months ago. However, as the half-hourly trains of the London & Northwestern Company, which run from the Mansion House to Broad Street, were still being operated by steam locomotives, the service was handicapped. These steam locomotives have now been replaced by electric locomotives, which are attached to the train at Earl's Court. Mr. Yerkes and the engineers of the Metropolitan District Railway Company are to be congratulated on this most satisfactory completion of their great work, which will now be followed up rapidly by the other underground railways with which Mr. Yerkes is associated. It is to be hoped that the Metropolitan Railway Company will also soon make a special effort to get the steam-drawn trains, which are still running over its portion of the system, withdrawn. On the whole southern portion of the Inner Circle from Aldgate to Earl's Court, there are no steam-drawn trains, but unfortunately on the northern portion of the circle, owned and operated by the Metropolitan Railway, a good many steam-drawn trains are till in service. One of the immediate results of the withdrawal of the steam trains from the Metropolitan District Railway, is the very appreciable quickening of the whole train service. A long as the steam trains were in operation, the electric trains had to wait at the station for considerable time, as they had to run on the schedule of the old steam trains. Now that these have been withdrawn, the increase in speed is appreciable over all the line, and as soon as the automatic signaling devices are completed, it is understood that a still further increase will be possible.

The London County Council is now definitely committed to the promoting of a bill in Parliament for supplying electricity in bulk to London, and the various committees have been in consultation with Sir Wiliam Preece, Robert Hammond, John F. C. Snell and others. From the strong opposition which this bill will receive, it has already undoubtedly been modified, and the scheme now submitted will provide for the co-operation of the London County Council with the already existing authorities and companies which are now producing electrical energy. It is proposed that for the present the supply should be taken from the Greenwich power house, which the Council has been erecting for the last two years to provide power for the electric cars, and for this purpose that station would be hurried towards completion. It is also intended to proceed with the erection of another station in the west of London on the banks of the Thames, near the Grosvenor Road Railway bridge, on a site which is now possessed by the Metropolitan Water Board. On this property, a station with a capacity of 80,000 kw would be built. The total capital necessary for such a scheme would be about £2,500,000, the expenditure being spread over a period of seven years. This is not the whole expenditure, however, that the London County Council is committed to at present, as it has also decided to proceed with a bill to acquire a site for the proposed new County Hall. This will involve an estimated expenditure of £1,700,000. It has also decided to proceed immediately with the electrification of the northern system of tramways, and the immediate expenditure necessary for that is the sum of about £800,000. This section of the northern system comprises the lines between Theobald's Road and London Docks, Norton Folgate and Stamford Hill. Aldgate and Poplar, Moorgate and City Road, Holborn and Theobald's Road, and Old Street and Shoreditch. The committee hopes to have the lines in working order about the end of 1906.

It is now possible to give a little further information regarding the promotion of an electric power scheme referred to last month. This scheme is now generally known as the "St. Neots," or "railway" power scheme, and a syndicate has been formed with the necessary capital to promote the bill in Parliament. The directors of the syndicate are stated by the articles of association to be Stanley Boulter (chairman), George Kitchin, and H. A. Vernet, and the names of the members of the syndicate comprise a very influential body of men. The engineers mentioned in connection with this bill are Messrs. Kincaid, Waller, Manville and Dawson.

The object of the bill is the supply of electric energy in bulk to railways, Metropolitan Borough Councils, and existing electric supply companies. The promoters are, we understand, directing their attention mainly to the supply of the great London railways, for the electrification of whose suburban traffic a very large amount of power will in the near future be required; but negotiations are also pending for supplying in bulk municipal and other electric undertakers. The promises of support which the St. Neot's scheme has received from railway companies show that the promoters are fully alive to the importance of having a strong group of capitalists ready to assist them by providing the money necessary for a great electric power scheme, which will obviate the necessity of the railway companies themselves adding to their own capital.

During the past month the electric tramways of the Corporation of Belfast have been formally opened and duly put into regular service, and the contractors, J. G. White & Company, of London, are to be congratulated on the successful completion of a most important piece of work. The usual ceremonies in connection with the opening of a system were held, when the Lord Mayor, as in most other towns, had the honor of driving the first car, accompanied by many of the other officials of the Corporation, together with Mr. Fisher and Mr. Connett, representing J. G. White & Company, the contractors. The first run was along Bedford Street, Dublin Road, University Road, and Malone Road, as far as Cranmore Park; the return route being made by the same route as far as Ulster Hall, whence they proceeded, via Ormeau Avenue, to Rosetta, and then back to Donegal Place. Altogether, a distance of 17 miles was traversed, and as the arrangements had been most carefully planned under the personal supervision of Mr. Nance, everything went off with the utmost success. The usual Board of Trade inspection duly took part, and everything was approved by Major Pringle, the representative of the Board of Trade on this occasion. It is hoped to give some further details of this interesting equipment in these columns on another occasion.

Parliament will be asked in the forthcoming session to sanction a scheme under which a company will be incorporated and granted power to construct and use various tramways and tramroads in the parish of Huddersfield, in the county borough of Huddersfield, the parish of Rastrick, in the borough of Brighouse, and the parishes and urban districts of Elland, Greetland and Hipperholme, and in the parishes of Fixby and Clifton, in the rural district of Halifax.

In the hope of overcoming some of the congestion of traffic at the Elephant and Castle, South London's most dangerous street crossing, Southwark Borough Council is considering the advisability of building a street subway, to cost from £10,000 to £13,000, for pedestrians. For years the "six ways" at the Elephant and Castle have constituted one of the most congested junctions in London streets, and the growth of the County Council's electric car service has increased the trouble.

In proceedings in the Chancery Court of Lancashire, it was announced that the undertaking of the South Lancashire Electric Traction Company had been sold for £150.000 to Arthur Stanley, M. P., who was acting on behalf of himself and other debenture holders. It is now stated that all the capital for the new company has been subscribed, and that the whole of the work is expected to be completed in 12 months' time, when Manchaster and Liverpool will be linked up. When the tramway lines are extended through Worsley and Walkden to Eccles and Swinton it will be possible to travel by car from Manchester to Liverpool.

A company has been formed to erect a transporter bridge across the Tees from Middlesbrough to Port Clarence in place of the present horse and car ferry, and also to construct in connection with it a light railway or tramway from Middlesbrough to Port Clarence, Billingham, Cowper Bewley, Greatham, Seaton, Seaton Carew, and West Hartlepool. As the scheme is in competition with the Middlesbrough Corporation ferry service, opposition to the powers to be sought is not unlikely.

The official opening of the electric tramway service through Alexandra Park recently, marks the commencement of a new era in the "life" of the great house on Muswell Hill. The difficulty in the past has been to get easily and cheaply to the Palace; the democratic electric car has once for all settled this, as it is now possible

for visitors to get from almost any part of London, by traveling in conjunction with the L. C. C. tramways, to within a few feet of the portals of the Palace itself.

Sir Francis Cory-Wright started the new service at Turnpike-lane, and within a few minutes the first car, containing the directors of the Metropolitan Electric Tramways, Ltd., drew up at the terminus.

Another has been added to the schemes for constructing tramways in the Macclesfield district. The promoters are a syndicate which includes a member of well-known tramway directors, and it is announced they intend to construct lines through Tytherington, Butley, Adlington, Poynton, and on to Hazel Grove, where they will join the Stockport tramways, making a total length of line of 18 miles. It is also probable that another scheme for a tramway from Macclesfield to Knutsford will shortly be announced.

The Croydon Borough Council has refused the offer of the British Electric Traction Company for the renewal of the lease of the tramways, which the company has been working since the electrification of the system five years ago. The questions of municipalization will be considered at a future meeting, but Alderman Stapleton, chairman of the tramways committee, said the committee regarded complete control by the Corporation as the only alternative to the company's offer. The lease of the system expires next year. The offer made by the company, and now rejected, was equivalent to an extra payment of £4,000 a year to the Corporation.

Major Druitt, of the Board of Trade, recently inspected the new electric tramways between Dewsbury and Birkenshaw, the construction of which has just been completed. The old steam cars ceased running at the beginning of August, and as 4 miles of rails (a good portion double) have been laid, the contractors (Dick Kerr & Company) have lost no time in finishing the work they have had in hand. The Batley, Dewsbury Corporations, and the Birstal, Gomersal, and Birkenshaw District Councils, were represented at the inspection, while there was also a large number of officials from the British Electric Traction Company and the Heavy Woollen District Tramways Company. There was no hitch in the running of the two cars by which the party traveled over the route, and a public service was started at noon. A. C. S.

PARIS LETTER

(*From Our Regular Correspondent.*)

The automobile exposition now being held at the Grand Palais has brought more than ever into prominence the fact, that Paris lags far behind other great European capitals in respect to motor omnibuses. The reason is not far to seek when it is remembered that the omnibus lines form a concession—formerly a monopoly—operated by a single company. The franchise expires in a very short time, less than three years, and the doubt entertained by the company in respect to its renewal, regarding which nothing definite can be obtained from the municipality, is responsible for the hesitation shown by the Cie Generale des Omnibus in placing mechanically-operated vehicles on the streets. In view, however, of the possible renewal of its franchise, the Cie Generale has now definitely taken in hand the question of mechanically-propelled buses, and for several months past experimental buses have been running loads with sand bags for freight. During the present automobile show a line of nine mechanically-operated buses has been plying between the Bourse and the Grand Palais. The company states that if sufficient encouragement is shown by the municipality it is prepared to place in public service several lines of motor buses. One of these lines is to be operated with buses whose motors will use alcohol for fuel. The price of this fuel is not exorbitant, as compared with the price in Paris of gasoline, and it can be obtained for commercial purposes at about 8 cents a litre or less. The price of gasoline in Paris is high, on account of a heavy import duty, and also an octroi tax, which latter is 4 cents per litre. Thus the price of gasoline for motors is close to 12 cents per litre.

Meanwhile, the surface traction situation in Paris remains still in a very critical stage, and nobody can foretell the next move, or the future policy of the municipality. It is pretty certain that nothing like municipalization of the tramway service on a large line will be attempted or suggested for the present, the situation being less favorable in this respect than with regard to the lighting concession, which is also in suspense together with the question of gas monopoly. The transport question is sure to come up for discussion sooner or later, but in the meantime the public, as well as investors on the stock market, are apparently losing confidence, and stocks and shares of Paris transport companies have recently sustained a sharp reaction. It cannot be said that this is in any way due to the intention of the municipality in regard to municipalization of the tramway service, since this matter is being very tenderly approached by the authorities, the conflicting interests being too great to lightly suggest any sudden change. At the same time it cannot be denied that several companies are keeping the matter in mind and are ready to carry on a strong fight if the matter happens to be touched upon.

The receipts of the Paris General Omnibus Company, have, throughout 1905, shown a steady decrease on the figures of the preceding year, the loss of receipts being in the neighborhood of $10,000 per week and over.

THE A. E. & C. AND THE E. A. & S. CONSOLIDATION

L. J. Wolf, president of the Aurora, Elgin & Chicago Railway Company and the Elgin, Aurora & Southern Railway Company, has sent an official announcement to the stockholders of these companies, of a plan for the consolidation of these properties along the lines referred to recently in the STREET RAILWAY JOURNAL. The plan also contemplates the building of a short spur line, from which he states large revenue can be derived from funeral and cemetery traffic, and the consolidation of this line with the consolidation mentioned. Possibly a second short spur line may be built. The new company will be known as the Aurora, Elgin & Chicago Railroad Company, capital stock $6,200,000, half preferred. Stock will be distributed to stockholders of the old companies on the basis mentioned last week, leaving $100,000 to pay for the spur line mentioned. The directors of the two companies will meet within a few days to ask authority to bring about the consolidation.

ANNUAL MEETING OF THE BOSTON ELEVATED

The annual meeting of the Boston Elevated Railway Company was held at Wesleyan Hall last week. President Bancroft presided, with John T. Burnett as secretary. There were less than a dozen stockholders present. The following were re-elected directors by a vote of 83,252 shares out of 133,000 outstanding: Frederick Ayer, William A. Bancroft, John J. Bright, Samuel Carr, T. Jefferson Coolidge, Jr., Frank E. Peabody, James Phillips, Jr., James M. Prendergast, N. W. Rice, Quincy A. Shaw, Jr., William S. Spaulding, Walter S. Swan and Robert Winsor. The annual report of President Bancroft was printed in the last issue of the STREET RAILWAY JOURNAL. Appended are some remarks by Mr. Bancroft of the present condition of the company:

"Work upon the extension of the elevated structure to Forest Hills has been prosecuted. Plans have been made, much of the steel material for the structure has been got out, and the foundation piers have been built for about half the distance between Forest Hills Square and Dudley Street. It is expected that the erection of the structure will begin in the spring.

"The East Boston tunnel has been in successful operation during the calendar year, and cars of large size have been in use therein. One of these cars, seating 52 persons, was designed and built by the company, and, with minor changes, will probably be adopted as a type with which to fully equip the lines which enter the tunnel. Forty other cars, all of large size, seating 48 persons each, have been bought, and some of them are in use in the tunnel, others are in use on the lines reaching the elevated trains at Sullivan Square.

"Much progress has been made by the Boston Transit Commission in constructing the tunnel under Washington Street. The route and the location of stations so far have been satisfactory to the company, and, it is believed, most convenient for the public.

"The operation of the new schedule of wages adopted two years ago has increased wages during the last year $170,834. The increase in the total number of revenue passengers for the entire systems was 2.18 per cent, as against about 3½ per cent in 1904, and 5 per cent in 1903. Unusual attention was paid to the care of the company's surface tracks, $622,849 having been spent thereon in renewals and repairs. This exceeded the amount spent in the previous year by $169,179. It is believed that the company's tracks were never before in such excellent condition. The extension of the surface tracks amounted to 1761 miles, making total length of surface tracks controlled by the company, including that leased from the Old Colony Street Railway Company, 431.891. This with the elevated mileage of over 16 miles, makes a total mileage of 447.906 miles."

The report announces that the company received a premium upon its issue of $7,500,000 4 per cent 30-year bonds sold last April of $276,900, showing that they were sold at 103.692. The income account and balance sheet have previously been published.

BRITISH COMMENTS ON THE NEW YORK CENTRAL.—NEW HAVEN SITUATION

Some interesting letters have recently appeared in the "London Times" on the subject of single-phase locomotives on the New York, New Haven & Hartford Railroad, which has attracted so much attention in this country. The contributions of Prof. Silvanus P. Thompson, H. F. Parshall and Prof. Alexander B. W. Kennedy, which are the most interesting of those which have appeared, are reproduced below.

Technical College, Finsbury, Oct. 23.

Sir:—The letter of "British Engineer" in "The Engineering Supplement" of Oct. 18, commenting on the paragraph entitled "Development of Electric Traction," on page 264 (Oct. 11), which referred to the development of single-phase electric motors for propeling trains on the New York, New Haven & Hartford Railroad, exhibits the very quality which its writer condemns. He objects to the severe criticism of the third-rail system as being likely to prejudice the public mind, and describes the paragraph as a sweeping condemnation of the views held by British engineers, whom he represents as unanimous in upholding the system of employing a third rail, the system adopted with continuous currents at a relatively low voltage on the Inner Circle System. But this presentation is surely an exaggeration. It is notorious that engineers are by no means unanimous in their approval of this system. One has only to look at the mass of conductors piled against the walls of the tunnels between Earl's Court and Charing Cross to realize what a disproportionate expenditure on copper this system involves. That wall of copper conductors is a striking object lesson of how not to equip an electric railway. I need not enlarge on the difficulties of the third-rail system in the complications of crossings, sidings and shunting-yards; they are only too obvious. It is notorious that changes have already been suggested—too late, I fear—in the system of the District Railway. The old obstinacy of refusing to admit the virtues of anything that "has yet to be tried, at any rate, in this country," is characteristic of too many "British engineers." They shut their eyes to the experience that has already been gained in single-phase propulsion with overhead conductors, in Germany, in the United States, in the Valtellina, and in the Stubaithal. Only when an order is placed with the Westinghouse Company for twenty-five locomotives, of 1000 hp each, which work with single-phase current and dispense with the third rail, do they wake up to cry out that "experience with the newest system does not justify a sweeping condemnation of the views held by British engineers." Perhaps it does not; but it justifies a sweeping condemnation of those British engineers whose vision is limited to those "views." By holding narrow views they have done their best—or worst—to rivet on our British railways, regardless of the progress of invention, "the dangerous, inconvenient and expensive third rail."

I am, sir, yours faithfully,
Silvanus P. Thompson.

Salisbury House, London Wall, E. C., Oct. 26.

Sir:—It is not my intention to enter the lists as a champion of either the high-tension alternating current or continuous-current systems for the propulsion of trains. I fully recognize that under given conditions either system may be the more advantageous. I may, however, take exception to the arguments advanced in favor of the universal use of alternating-current motors. Broadly speaking, the advantages and disadvantages of each system are very largely of a commercial nature. I was among the first to employ alternating current in traction work, but I stopped short of using it in the distribution system. The limitations which then seemed present still exist, and, under identical working conditions, prevail to the same extent.

There is no doubt that an alternating-current train system can be made as reliable as a continuous-current system. However, where runs are short and the greater part of the work to be done lies in accelerating and maintaining speed rather than running at fixed speed, the motors required for the alternating-current system are much heavier than for the direct-current system. In the extreme case of acceleration to which continuous currents are applicable the weight of the alternating-current equipment is prohivitive. The main question to be decided in all cases is the balancing of additional cost of train equipment against diminished cost in transmission and transformation. The difference in electrical efficiency may be taken as unimportant. With the same general transmission system the lower power factor and lower efficiency of the alternating-current train equipment may be taken to offset the energy losses of transformation in the continuous current as commonly used in the heavier class of railway work.

A great deal has been said as to the objectionable features of the commutator of the continuous-current machine. It has, however, been found to be practically impossible to develop an alternating-current motor suitable for traction work, without a commutator similar, but larger, than that employed in the continuous-current system. Furthermore, a high-tension transformer is necessary to secure the full advantages of the alternating-current system.

Referring more specifically to Prof. Silvanus Thompson's recent letter, I may point out that the limiting feature of the alternating-current system, apart from that of the motors under acceleration, is the drop in the return circuit if uninsulated. This drop is several times greater in the alternating-current system, per ampere, than in the continuous-current system. In heavy working an insulated return or its electrical equivalent becomes a necessity. Experiments have shown the impracticability of working a heavy train service by alternating currents with track return, in any locality equipped with systems of telegraphs and telephones.

As regards first cost, the third rail is much cheaper than the ordinary overhead system; but this, however, is not the determining factor. As regards reliability, experience is clearly in favor of the third rail. As regards the danger of the third rail, experience shows that, even when unprotected, accidents are very rare. In a specific case in London, an overhead system, installed under the best auspices for heavy haulage over a complicated network of tracks, was found to be a failure, and was replaced by the third-rail system, which was found to be entirely safe and reliable.

While I am in no way interested in the District Railway installation, I would point out that the particular cables to which Prof. Thompson alludes are for alternating-current transmission, and are not incident to the use of the third rail. Were the alternating system used throughout, the number of these cables would have to be greatly increased.

I do not for a moment suggest that there are not conditions under which I would apply alternating current generally in a traction system. I have investigated the conditions under which this alternating current has been applied on the Continent and in the United States. For the lighter class of railways, working over considerable distances with moderate acceleration and moderate tonnage, a single-phase system possesses certain commercial advantages. The New York, New Haven & Hartford Railway is a locomotive installation. Hence the acceleration is limited, and a class of apparatus is permissible that is entirely unsuited to motor-car working. In my opinion, the relative applicability of the two systems is wholly one of degree, and there is no general prescription which can be safely or reliably applied in the economical propulsion of trains.

I have heretofore pointed out that in an electrical system the third rail is the most reliable and the least troublesome element in the whole traction system, as either the evidence of the Board of Trade or the responsible officials of the different electrical railways will confirm. The third rail has been singled out as the evil peculiar to continuous-current systems. When the same conditions are met in an alternating-current system, it remains to be seen whether it can be dispensed with.

It has been suggested that the third rail was not the creation of an electrician. I believe the Hopkinsons first suggested this form of conductor. Considering that it has been adopted, practically universally, for heavy traction by the engineers most responsible for the advanced state of the art, it cannot be lightly put aside and superseded by something yet to be proved suitable for the same class of work.

In conclusion, I may point out that the broad problem before electrical engineers is to demonstrate, from experience gained in electrical working, the conditions under which electricity may profitably compete with steam. The solution of this problem is not so self-evident that time-tried inventions can be casually set aside.

I am, sir, yours faithfully,
H. F. Parshall.

17 Victoria Street, S. W., Oct. 31.

Sir:—In reference to Prof. Silvanus Thompson's letter of the 23d inst., in "The Engineering Supplement" of Oct. 25, I think it is only fair to ourselves to point out that the adoption of the "third-rail" system on the District and Metropolitan Railways was not due to any conservatism or obstinancy on the part of British engineers. Quite the contrary. It was due entirely to the pressure of American engineers on the arbitrator that no system except the "third rail" could possibly be commercially successful under the circumstances, and to the statements made that the American financial people would work on no other system. These considerations weighed so much with the learned arbitrator that he entirely threw out the alternative Valtellina system, and he also ruled (which was much more important) that he could not receive evidence as to any other alternative. Many English engineers, including myself, both believed and pointed out, long before the matter was taken up (as I

am glad it has been) on the Continent and by the Americans, that the single-phase system, with one overhead conductor, was the only probable solution of the heavy railway question, and our opinions seem now to be shared by engineers generally.

Yours, faithfully,

ALEX. B. W. KENNEDY.

AFFAIRS IN CHICAGO

At the recent conference of the city officials and the officers of the companies regarding the operation of more cars during the rush hours, the traction interests advanced the plea that the substitution of the trolley for the cable is the only remedy for overcrowding and the congestion of traffic in the down-town districts. With this opinion A. B. Dupont, who has been acting as personal adviser to Mayor Dunne, agreed. Mr. Dupont admitted that the Union Traction Company had reached the limit of its power capacity, and that few more cars could be operated where needed on the Chicago City Company's terminals. Conferences between President Roach of the Union Traction Company and President Mitten and General Counsel Bliss of the Chicago City Company on the one side, and Jacob G. Grossberg and Dr. M. F. Doty of the local transportation bureau, and Mr. Dupont, representing the city on the other, occupied most of the day. In the morning the city's representatives pointed out to President Roach the congested conditions of the North and West Side lines and asked him to remedy them. Mr. Roach said the company was operating all the cars its engine capacity would permit. He said the power now used exceeded the safety limit, and that it would be impossible to put more cars on the cable lines because the cable engines could not propel them. Mr. Mitten said the only relief for the congestion on his lines was to convert the cable in State Street into a trolley. If this was done, thousands of passengers would use the line who now go to Indiana or Wentworth Avenue to come down town, because of the superior accommodations offered by the electric cars. He thought the trolley on the State Street line to Van Buren, and Van Buren between Wabash Avenue and State, would add to the terminal facilities during the rush hours. He proposed a loop on Wabash Avenue, State, Van Buren, and Eighteenth Streets. Mr. Dupont favored bringing the trolley down town. Dr. Doty will report the suggestions to Mayor Dunne.

At the joint meeting of the local transportation and track elevation committees, ordinances were considered for the extension of the franchises of the Chicago & Oak Park Elevated Companies until 1944, and the construction of two branches to that line—one on Western, North, and California Avenues to Humboldt Park, and the other between the Belt Railway and Forty-Ninth Avenue to Augusta Street, and thence to the city limits. These ordinances were considered in connection with the elevation of the tracks of the Northwestern steam railroad and the surface tracks of the Chicago & Oak Park Company through Austin. No action was taken.

Representatives of the traction companies have notified Corporation Counsel Lewis that they intend to attack the validity of the Kohout ordinance and other measures regulating the street car service. The attacks will be based on the indefiniteness and unreasonableness of the ordinances. General Counsel Gurley, of the Union Traction Company, has had a conference with Mr. Lewis and Special Counsel Grossberg and has arranged for the postponement of the cases now pending in the justice courts until after the hearing in Washington. Mr. Gurley said he and John P. Wilson, representing the Chicago City Company, would attend the trial of the cases for the purpose of laying a foundation for an injunction suit to restrain the city from attempting to enforce the ordinances regarding the heating, ventilating, and crowding of cars. Mr. Gurley said the ordinances did not define what constituted overcrowding of cars, whether any passengers should be allowed in the aisles or on the platforms. Another point urged against the validity of the ordinances was that they provided a penalty of $50 for violating any of their provisions. Mr. Gurley said some of the violations might not be sufficiently punished with $500 fines, while in other cases $1 would be an ample penalty. It will be argued that it is impossible to enforce some of the provisions of the ordinances and that for this reason they are illegal. Major Tolman will open the arguments on the merits of the case and will be followed by Glen E. Plumb on the same line. Clarence S. Darrow will close the arguments for the city covering the entire case. Attorneys for the Union Traction Company will alternate with the city's lawyers. S. S. Gregory will act as general adviser in the case. Two cases will be argued at the same trial. In one case the company has appealed because Judge Grosscup did not hold that the 99-year act covered all its lines, and in the other the city is the appellant because Judge Grosscup recognized the validity of the 99-year act in any particular.

MILWAUKEE COMPANY TO ISSUE BONDS

The Milwaukee Electric Railway & Light Company, which is controlled by the North American Company, has taken steps to issue $20,000,000 of 4½ per cent twenty-five year bonds, to be used in part for the retirement of present bond issues and partly to provide capital for extensions and improvements. The stockholders of the company will meet in Milwaukee on Jan. 5, to authorize the new issue. About $8,000,000 of the bonds will be reserved to retire at maturity the bonds of the Milwaukee Railway & Electric Company's subsidiary concerns. This will leave about $12,000,000 of bonds available for increasing the facilities of the company.

The Milwaukee company owns all the railway lines in Milwaukee, as well as all the lighting plants, and supplies, in addition, a large amount of electric power. The demand for the latter, it is said, has outgrown the facilities of the company, and it is intended to largely increase this branch of the company's business.

The entire issue of bonds has been underwritten by three New York banking houses, Spencer Trask & Company, F. S. Smithers & Company, and N. W. Harris & Company. The present bondholders will have an opportunity to exchange their holdings for bonds of the new issue The company has outstanding $8,000,000 of common and $4,500,000 of preferred stock.

NEW POWER PLANT IN HARRISBURG

The Central Pennsylvania Traction Company, of Harrisburg, is excavating for its new power plant, which will be located adjacent to its old No. 1 plant on South Cameron Street, Harrisburg. The new plant will be of ample capacity to take care of all their power requirements for the immediate future and will replace three plants the company now has in service.

The building will be 175 ft. long, 102 ft. wide and about 40 feet high. It will be constructed with a steel frame which is being manufactured by the bridge and construction department of the Pennsylvania Steel Company. Walls will be built entirely of concrete filled in between the steel columns.

The equipment will consist of three horizontal cross compound, condensing Corliss engines of 1000 hp, now building by the Allis-Chalmers Company, of Milwaukee, Wis. Each engine will be directly connected to a 650-kw generator also furnished by the Allis-Chalmers Company. These units will have a capacity of 50 per cent overload for short periods, thus giving a maximum capacity for the entire plant of about 4500 hp.

The engine room will be 50 ft. wide and will extend the full length of the building, 170 ft., and will face Cameron Street. Large windows in the face of the building extending to the engine room floor, which will be 9 ft. above the street level, will give a full view of the interior of the engine room from the street. A traveling crane operated by electric motors will serve the entire engine room floor and will have a capacity of 30 tons. The boiler room, which will occupy the rear portion of the building, will be 45 ft. wide and extend the full length of the building, and will contain for the present five 327-hp horizontal water-tube boilers now being manufactured by E. Keeler Company, of Williamsport, Pa. All of the above equipment will occupy only one-half of the floor space of the building, ample room being provided for installation of additional boilers and engines as the growth of the system requires, so that the plant will have an ultimate capacity of 9000 or 10,000 hp.

The stack will be built of reinforced concrete by the Weber Steel Concrete Chimney Company, Ill. It will rest on the solid rock about 20 ft. below the present ground level and extend 210 ft. above the foundation and will be 10 ft. in diameter inside. A railroad siding connecting with both the Pennsylvania and Reading Railroads will come into the yard running between the boiler room and the stack so as to facilitate the delivery of coal and the removal of ashes.

An interesting feature of the new plant will be the water supply tunnel. Plans have been drawn for, and work will shortly be started on, the boring of a 5-ft. tunnel in the solid rock 30 ft. below the surface of the ground, extending from the plant in a direct line under the yards of the Central Iron & Steel Company to the river. From the river bank a 36-ft. cast-iron pipe will extend nearly to the island, at which point in the river the best quality of boiler water is to be obtained. This water-supply tunnel will be built and used jointly by the Traction Company and the Central Iron & Steed Company.

All of the work is being carried out from plans prepared by and under the direction of Mason D. Pratt, consulting engineer, of Harrisburg, and W. C. Gotshall and C. O. Mailloux, of New York City, acting as advisory electrical engineers. The total cost of the plant will approximate $250,000.

DEATH OF CHARLES T. YERKES

Charles Tyson Yerkes, of the Underground Electric Railway Company, Ltd., of London, England, who has been sick in his apartment at the Waldorf-Astoria, New York, since coming to this country from London early in November, died on Friday afternoon, Dec. 29, at 1:30 o'clock. The end was not unexpected, and there were with him when he died Mrs. Yerkes, his son Charles T. Yerkes, Jr., and other members of the family. Mr. Yerkes suffered a serious decline early in the week, and his life was protracted only by heroic efforts on the part of his physicians.

C. T. YERKES

Mr. Yerkes is best known through his connection with the surface and elevated lines of Chicago, and the many changes which he effected in the traction systems of that city. He was born in Philadelphia on June 26, 1837. His career as a financier dated from 1859, when he started for himself as a stock broker. Soon thereafter he joined the Philadelphia Stock Exchange, and became one of the prominent dealers in State and municipal securities. In 1871, Mr. Yerkes succumbed to the panic following the Chicago fire, and was forced into bankruptcy. He retrieved these losses rapidly, however, and soon reaped a considerable fortune on the Exchange. His interests at this time were largely in Philadelphia railroad stocks. Again Mr. Yerkes suffered severe financial losses. Following this came a change in location by him that had its end in his settling in Chicago. From Philadelphia Mr. Yerkes went West as far as Fargo, N. D., where he engaged largely in real estate speculation. Chicago, however, offered larger possibilities, and Mr. Yerkes changed the base of his operations. Shortly after settling in Chicago he established a bank, and soon thereafter entered the Chicago traction field. Meanwhile he had married Miss Mary Adelaide Moore, of Philadelphia.

His entrance into the traction field in Chicago, which was in 1886, was marked by his purchase of the old North and West Chicago street railway systems. At that time horse cars were operated on the North and West Sides, but the South Side lines were operated by the cable system. The North and West Side lines comprised 64 miles of double track, with practically no cross-town lines and practically no system of transfers. There were no lines to the suburban districts and towns. Immediately, Mr. Yerkes began to unify the systems, install the cable on the principal lines and develop the suburban lines, with the result that after a few years there was a complete system of roads radiating from one central point, together with an extensive elevated system and a loop around the principal business district. From the original 64 miles of double track that came into his possession in 1886, he created a system of 297 miles of track and cross-town lines, 205 miles of suburban lines and 73 miles of single-track elevated lines.

Mr. Yerkes remained in Chicago fifteen years, or until 1901, when he disposed of his holdings in his surface lines to a syndicate of New York and Chicago bankers and capitalists, and to other investors of his stock in the elevated lines in Chicago. A recent visit to London had impressed him with the possibilities of the development of the transit facilities there, and he immediately prepared to enter actively that field. In London he formed the Metropolitan District Traction Company, Ltd., which was privately subscribed, and made plans for the building of some 140 miles of underground and surface tracks at an expenditure of at least $85,000,000. The systems which he succeeded in taking over and consolidating into the Underground Electric Railways Company, Ltd., were the Metropolitan District Railway, Metropolitan Railway, Great Northern, Piccadilly & Brompton Railway, Charing Cross, Euston & Hampstead Railway, Baker Street & Waterloo Railway. Later the system of surface lines of the London United Tramways was included. Extended reference to the projects of Mr. Yerkes in London are to be found in the Street Railway Journal of Nov. 21, 1903, and March 4, 1905.

At a special meeting of the Underground Electric Railway Company, of London, on Wednesday, Jan. 3, Edgar Speyer was unanimously chosen chairman, as successor to Charles T. Yerkes. Sir George Gibb, general manager of the Northeastern Railway, was elected deputy chairman and managing director. Sir George also becomes chairman and managing director of the District Railway. Robert William Perks will remain deputy chairman of the District Railway. Resolutions of regret at the death of Mr. Yerkes were passed.

Sir George Stegmann Gibb, LL. B., was born in Aberdeen, Scotland, April 30, 1850. He became assistant in the Great Western Railway Company solicitor's office in 1877, solicitor to the North Eastern Railway Company in 1882, and general manager in 1891. He was a member of the Royal Commission on London Traffic in 1903, and was a delegate to the International Railway Congress, held in Washington last spring. He was one of the first to introduce electric multiple-unit trains for the working of branch-line passenger traffic, and electrified a section of the Northeastern system near Newcastle.

SCRANTON RAILWAY SOLD

The American Railways Company has purchased the Scranton Railway Company. Both common and preferred stocks are taken over at par ($50) a share. The company is a consolidation of various street railways in and around Scranton. It has $1,500,000 of 5 per cent cumulative preferred and $2,000,000 of common stock. Dividends at the rate of 2½ per cent semi-annually began on the preferred stock in March, 1904.

E. W. Clark & Company, of Philadelphia, have sent the following notice to stockholders of the Scranton Railway: "We beg to advise you that we have entered into a contract to sell to the American Railways Company a controlling interest in the preferred and common stocks of the Scranton Railway Company, reserving in the contract of sale the right for all stockholders to participate in the sale on the same terms. Stockholders desiring to avail themselves of this offer should immediately deposit with us their common and preferred stock certificates, with the powers of attorney properly executed in blank, and we will deliver to them, in due course, the cash and new securities to which they are entitled under the terms of the sale, common stock, at par, $50 per share; $25 cash on Jan. 5, 1906; $25 cash on or before Dec. 15, 1906. The American Railways Company will give its notes, bearing 5 per cent interest per annum from Dec. 15, 1905, for the deferred payment, secured by the common purchased. We will hold these notes and said stock as collateral, and will issue our negotiable certificates of participation in the loan to the holders of common stock entitled thereto, reserving the right, however, to sell the notes at a price sufficient to pay the certificates of participation at par and accrued interest. Preferred stock, at par, $50 per share, payable in 5 per cent registered gold trust certificates issued by the New York Trust Company, of New York, under agreement with the American Railways Company, and secured by deposit with said trust company of preferred stock of the Scranton Railway Company, equal in par value to the certificates issued. These certificates will be dated Sept. 1, 1905, the date of the last preferred dividend, and will mature on Sept. 1, 1905, with the right of purchase at any semi-annual payment date after March 1, 1907, at the option of the American Railways Company, at 102½ per cent, together with semi-annual payments due thereon. The first semi-annual payment of $25 will be made on March 1, 1906. The certificates will be for $1,000 each, and scrip will be issued for fractions convertible into certificates when presented in amounts of $1,000 or multiples thereof. We shall be prepared to buy or sell scrip at 97½ per cent. A charge of $1 per share on the common stock will be made to cover legal and other expenses and commissions, and will be deducted from the cash payment of $25."

REPLY FROM PRESIDENT McCARTER

An article devoted to politics in Jersey City, from the pen of Lincoln Steffens, appears in the current issue of McClure's Magazine. In this article an attempt is made to connect President McCarter, of the Public Service Corporation, with using influence with his brother, the Attorney-General of the State, by which the latter declined to bring proceedings against the Corporation, as requested by Mayor Fagan, to terminate the franchise of one of the lines in Jersey City. The incidents related in the article were so largely overdrawn that the charges have fallen flat, and are still further discredited by a statement made last week by President McCarter. In this Mr. McCarter states that he had no conversation with his brother on the subject until after the failure of the proceedings. He also pointed out various legal defects in the bill advocated by Mayor Fagan, which were amply sufficient to warrant its failure at Trenton.

BINGHAMTON EMPLOYEES MAKE PRESENTATION TO THE PRESIDENT AND THE GENERAL MANAGER

G. Tracy Rogers, president of the Binghamton Railway Company, of Binghamton, N. Y., was presented with a gold-headed ebony cane, with monogram, and J. P. E. Clark, general manager, was presented by the employees with a gold watch made by Agassiz in Geneva, Switzerland, with monogram, on the afternoon of Sunday, Dec. 24. Each gift was accompanied with a pretty book with a list of the employees and with the following note of presentation: "Deeply appreciative of your kindness, we ask you to accept this gift as an evidence of our sincere esteem. We wish and earnestly hope that you may enjoy many merry Christmases and happy New Years." Mr. Rogers and Mr. Clark have been identified with the Binghamton Railway Company in an official capacity for sixteen years, and many of the employees included in the list of donors have been in the employ of the company for more than ten years. Their action speaks volumes for the pleasant relations existing between employer and employee.

One of the local papers in Binghamton, commenting editorially upon the feeling existing between the management and the employees as exemplified by the presentation, said:

"It seems to be possible for employers and employees to get along harmoniously. The discipline of the road is very strict, and any one caught at what endangers the public, the property of the company or its good reputation is bounced at the drop of the hat. All the employees understand that as well as the employers do. The employees have learned to like the strict discipline, for the reason that it is protection for them, and brings them in the company of all good men. The gentlemanly conduct of the conductors and motormen is the wonder of the traveling public. President Rogers and Manager Clark know exactly how to run a railroad. To gain the good will of the employees is a science worth knowing. Many such enterprises have failed through lack of such knowledge."

CLEVELAND ELECTRIC RAILWAY AFFAIRS

Directors of the Cleveland Electric Railway Company have declared a dividend of 1¼ per cent, payable Jan. 5, which places the stock on a 5 per cent basis instead of 4 per cent, as in the past.

The directors, as previously noted in the STREET RAILWAY JOURNAL, have decided to allow the employees to share in the increased earnings of the company, and voluntarily announced an increase in pay of all employees. The new scale for motormen and conductors is 21 cents for first year, 22 cents for the second year, 23 cents for the third year, and thereafter 24 cents an hour. This was a most agreeable Christmas present to the men.

Charles Otis has retired as a director, and Samuel Mather has been elected in his place; otherwise the directors and officers remain as heretofore. It was announced that the gross earnings of the company this year will be $5,300,000, a gain of $550,000 over last year. Several new pleasure resorts and the opening of new lines were responsible for a considerable portion of the gain.

ACCIDENT FAKIRS CONVICTED IN NEW YORK

On Dec. 22, 1905, Recorder Goff, of New York, sentenced Isaac Bloom to State prison for seven years upon his conviction of the crime of perjury. Bloom brought an action against the Metropolitan Street Railway Company, claiming that he had been thrown while alighting from a car on Second Avenue on Dec. 9, 1901, and that he thereby received a shock which caused paralysis of one side of his body. Upon the trial of the case the attorneys for the Metropolitan Company proved that Bloom had been paralyzed a long time before the pretended accident, and that no such accident happened. The jury found a verdict against him, and he was thereupon arrested for perjury upon a warrant sworn out by James L. Quackenbush, the general attorney for the Metropolitan Company. It further appeared in the case that Bloom's attorney, Henry L. Slobodin, lived in the same house with him. Charges have been preferred against this attorney and are now pending before the Bar Association.

Bloom called as witnesses to the pretended accident three persons, who, it is said by the representatives of the Metropolitan, came from Albany to New York to attend the trial in a body. It is said that some of these witnesses will also be prosecuted.

On Oct. 17, 1905, Albert Woods and Mae Woods, his wife, were sentenced to terms of from three to five years in the State prison at Sing Sing, and from two to three years in the State prison at Auburn, respectively, by Judge Platt in the County Court of Westchester County upon their pleas of guilty to the indictment charging them with perjury in an action against one of the lines of the Metropolitan Street Railway system. The details of this case were given in the STREET RAILWAY JOURNAL for Oct. 21, 1905.

RADIAL SCHEME FOR TORONTO

The plan of Mayor Urquhart, of Toronto, for providing entrances into the city for the radial railways has been presented to the board of control, and is being held over for further consideration and reports from the city engineer and city solicitor. The scheme proposes an agreement between the city and the Toronto Railway Company, including its subsidiary concerns, whereby two lines of cars to accommodate suburban traffic will enter the city, one from the northwest and one from the east. The terms of the present agreement are to govern the construction of the new lines, and the same amount of mileage, $800 for single and $1,600 for double track, is to be paid annually, in addition to the percentage on traffic, excepting on freight, which is not to be taxed for the city's benefit for a term of years.

The St. Lawrence Market is to be the terminal of both lines and the northwest route will start at the head of Christie Street and reach the market as follows: Christie Street to Bloor Street, a short turn to Clinton Street, to Mansfield Avenue, to Claremont Street, to Queen, to Niagara, to Bathurst, to Front, to the market. The eastern route will start at the Kingston Road, on Queen Street, to Eastern Avenue, to Trinity Street, to Front Street, to the market.

The Metropolitan tracks are to be removed from Yonge Street at Mount Pleasant Cemetery and diverted west by St. Clair Avenue to the city limits, and the present city line would be extended up Yonge Street to effect a junction.

The tracks of the new lines are to be standard gage, 4 ft. 8½ ins., the same as the tracks of the present radial lines, and where the route of the city line is encountered, a third rail is to be laid, as its gage is 4 ft. 10⅞ ins. wide. The agreement provides that the lines shall come into the city's possession at the expiration of the franchise of the Toronto Railway Company, in 1921, according to the terms of the present agreement. The company is to have the right to purchase station grounds and make all necessary connections, and the city will lend its aid in case any crossings of steam railways are found necessary, but the city engineer is to govern in all things and all costs are to be borne by the company. Any differences arising are to be settled by the county judge, with right to appeal only to the Court of Appeal for Ontario, and a refusal to obey an order of the court is to entail forfeiture of the franchise.

In addition to providing for suburban traffic, the Mayor also has a scheme for a new passenger line to relieve the present congestion. He proposes tracks from the market up Jarvis Street to Adelaide Street, then west to Bathurst Street and along to Farley Avenue and Niagara Street, connecting there with the radial system.

INCREASE IN WAGES IN MILWAUKEE

Motormen and conductors of the Milwaukee Electric Railway & Light Company, who have been in the employ of the company for ten years, will hereafter receive 23 cents an hour. The advance in wages by the company is entirely voluntarily, and comes to nearly 200 men affected as an agreeable New Year's surprise.

The following notice, posted in the various company car houses, informed the employees of the advance:

To the Milwaukee Electric Railway & Light Company Motormen and Conductors:

"GENTLEMEN:—Commencing Jan. 1, 1906, the pay of motormen and conductors who have been in our service, in that capacity, continuously for ten years (10) years or more, will be increased to twenty-three (23) cents per hour.

"This increase is voluntarily and cheerfully granted as an evidence and expression of our appreciation of intelligent, faithful and long-continued service, and as an assurance that those longest in our employ will always be given the greatest consideration possible.

"Appealing to every employee of the company to make constant and patient effort to merit the good will and good word of the public, I beg to remain, with the best wishes for your advancement and prosperity,

Yours sincerely,

"JOHN I. BEGGS,

"President and General Manager."

This is the second voluntary raise in wages announced by the company in several years. The men start in the employ of the company at 18 cents an hour. After two years of service they receive 19 cents, after three years 20 cents, after four years 21 cents, and after that 22 cents.

NORTHERN OHIO COMPANY OFFERS PRIZE FOR TRADE MARK

Realizing the desirability of having some distinctive emblem to characterize the property, stationery and general literature of the company, the Northern Ohio Traction & Light Company has decided to adopt an appropriate trade mark, and invites the public to assist in the selection of this trade mark. For the suggestion that is accepted the company will pay the sum of $50. Twenty-five dollars for the first prize, $15 for the second, $10 for the third prize.

To give some idea of what is desired in the way of a trade mark the company calls attention to the emblems and designs used by the railroad companies—such as the maple leaf, an artistic arrangement of names and initials and colored designs of animal heads or allegorical subjects. All suggestions must of course be in the form of drawings or sketches. The mediums shall be ink, wash or even oil. Pencil drawings will not be considered, and emphasis is laid upon the necessity of simplicity of design. The suggestion is to be used on all the company's property and must be sharply defined and comprehensive. Of what is practical suggestion can also be found in the trade marks of some of the largest manufacturing concerns, the letter heads of clubs and a few hotels. This is not a coat of arms, but a trade mark.

All designs must be submitted by Jan. 18. The decision and award of this competition will be made by the staff officers of the company, to which all designs must be mailed.

ALTON ORDERS MORE GASOLINE CARS

The success of the gasoline-electric motor car now being tested by the Chicago & Alton Railroad on its line between Jacksonville and St. Louis has induced the management to give an order for the construction of six more of these cars, to be used in the establishment of interurban service between local points on its line throughout the State of Illinois. It is the intention to divide up the line into sections of about 25 miles each, and furnish this local service over this territory. Alton officials claim that by the operation of these cars they can cut down the cost of operating passenger trains from about 30 cents a mile to less than 3 cents a mile. It will enable them to increase materially the service and furnish much more satisfactory accommodations.

PRESIDENT SULLIVAN OF BOSTON & NORTHERN ACQUAINTS PUBLIC WITH FACTS OF STREET RAILWAY OPERATION

President Sullivan of the Boston & Northern Street Railway system gave a smoke talk, recently, before the Chelsea Board of Trade, at Knights of Malta Hall, on street railway matters in general and Chelsea street railway matters in particular. Mr. Sullivan compared the possibilities of the Boston Elevated Railway, operating an urban system, and a company operating largely in the outlying districts, like the Boston & Northern road. The Elevated, for example, has an average population of 2300 for each mile of track it operates. The Boston & Northern has an average of only 1100 per mile. The Elevated has an average income of $30,000 per mile of trackage, while the Boston & Northern has an average income of only $7,300 per mile of track. The average income per mile for street railroads in Massachusetts is $10,000, with the elevated trackage included.

President Sullivan surprised his auditors by saying the road's Revere Beach business was actually a handicap to it. "People see the heavy traffic to the beach in midsummer," he said, "and it appears to the onlooker that the road is 'coining money.' The capital invested is there 365 days in the year, but yields the company an income for only 20 days each year. In the old days, when the company operated by horse cars, we sold our horses at the end of the summer. Now the entire investment has to be retained during the 12 months."

In conclusion, Mr. Sullivan declared that it was his belief that street railroad companies in Massachusetts are at this time approaching a critical period. "They made large investments," he explained, "when the cost of operation was much lower than it is now. Since the time of those investments the price of rails has advanced from $19 to $27; there has been an increase of 40 per cent in the price of copper, an increase of from 25 to 30 per cent in the cost of cars; an increase of 50 per cent in the cost of motors, and other necessities for railroad operation have increased in proportion. I have seen the time when 1 cent was considered a good profit in street railroad operation, but now the stockholders are pleased to secure a profit of 6 mills."

MEETING OF THE CLEVELAND ELECTRIC CLUB

The Electric Club, of Cleveland, Ohio, had a "smoker" on the evening of Dec. 15, which was thoroughly enjoyed by a large number of members and their friends. The announcement stated that the meeting would be addressed by Charles F. Brush and Professor Elihu Thomson, and a number attended with expectation of seeing those gentlemen. As a matter of fact, the addresses were delivered via a phonograph, and at the same time that the phonograph was in operation, the portraits of the speakers were thrown on the screen.

In order to carry out the idea consistently, E. P. Roberts, president of the club, introduced the speakers via phonograph, and at the end of the introductory remarks called for a vote of thanks, and requested all of those in favor to say aye; and at the same time the record was being made, a number of men took part in the vote, and same was fully endorsed and strengthened by the shouts of those present when the record was used.

THE ANNUAL MEETING OF THE INDIANA ELECTRIC RAILWAY ASSOCIATION—INDIANA-OHIO CONFERENCE

The annual meeting of the Indiana Electric Railway Association will be held in Indianapolis on Monday, Jan. 11. The programme will consist of the annual address of President C. L. Henry, and the informal discussion of miscellaneous subjects. The question box is expected to afford some good subjects for discussion. The meeting will close with a dinner at the Claypool.

On Jan. 10, a committee from the Ohio Electric Railway Association will confer with a like committee from the Indiana association with a view to the amalgamation of the two associations. The plans in contemplation provide that the new association shall be known as the Central States Interurban Association. A salaried secretary is to be employed with headquarters in Columbus or Indianapolis.

UTICA & MOHAWK EMPLOYEES GET INCREASE

An increase in salary of two cents an hour has been voluntarily given the employees of the Utica & Mohawk Valley Railway. News of the increase was conveyed to the men in a letter from General Manager C. Loomis Allen, which was dated Dec. 25. This letter follows:

Utica & Mohawk Valley Railway Company.
Utica, N. Y., Dec. 25, 1905.

Dear Sir.—During our holiday season we frequently hear expressions of good cheer and well wishes for our happiness and prosperity. It is altogether fitting that one's good feelings should not alone be expressed in words, but in a more substantial and practical manner, and it gives me great pleasure to announce to you in behalf of the officers and directors of the Utica & Mohawk Valley Railway Company, that an increase in your rate of pay will be effective on Christmas morning, Dec. 25, 1905.

The rate of wages after that date will be as follows:

Motormen and conductors during their first year's service will receive 18 cents per hour, and for service rendered after the first year 20 cents per hour.

Motormen and conductors running on the interurban lines will receive 22 cents per hour.

The date of your entrance into the service of this company is ———, and your run is on the ——— division. You are therefore entitled to receive ——— per hour.

Wishing you a Merry Christmas and a Happy New Year, I am,

Yours very truly,

C. Loomis Allen, General Manager.

The average run is 10½ hours a day and there are seven working days in each week. There are about 300 conductors and motormen in the employ of the company, including regular and extra men, to all of whom the advance applies. The car starters, despatchers, men on the corners, the office clerical force and others were also given an increase in pay. To those who did not get an increase, $10 gold pieces were handed out by General Manager Allen. The men on the old Herkimer and the Oneida branches also share in the increase. The company calculates that the raise will cost about $18,000 a year, and if the force is increased, it will go above this figure. The schedule in force previous to the increase was 16 cents an hour for the first year, 18 cents an hour thereafter on the urban lines, and 20 cents an hour on the suburban or through lines.

NEWARK-NEW YORK HIGH SPEED LINE

It is stated that the project for one of the two proposed high-speed electric railways between Newark and New York is to be abandoned and that but one road will be constructed, to be controlled and operated by allied interests—the Pennsylvania Railroad, the Belmont-Ryan syndicate and the McAdoo tunnel promoters.

Within the last month public announcements were made of the plans of the Public Service Corporation in alliance with the Ryan syndicate and of William G. McAdoo, the Belmont syndicate and the Pennsylvania Railroad of new roads to be constructed. The Public Service proposed to establish its Newark terminal in Park Place, near East Park Street, while the McAdoo plans called for a subway with a loop around the Newark Court House to run under Market Street to Railroad Avenue, thence along the right of way of the Pennsylvania Railroad to the Passaic River, which was to be crossed by tunnel. Both plans were similar in that the roads were to be mostly underground.

According to the latest announcement, the line projected by the Public Service Corporation has been selected. It will extend underground from the Park Place terminal in Newark to the Passaic, cross that river by tunnel and continue over a private right of way through Harrison and Kearny to the Hackensack. In Jersey City the line will be partly underground and partly elevated, with some parts, owing to the peculiar topographical conditions, on the surface.

The McAdoo tunnels are to be utilized to carry the road under the Hudson to Manhattan, where it will reach four different points. It will connect with the surface railroads in Newark and Jersey City, and in New York connections will be established, according to the report, with the subway and surface lines, the Pennsylvania's main line to Long Island, and with the New England railroad systems.

It is said that the new plan has received the full approval of both the Belmont and Ryan interests, and that most of the details of the agreement have been perfected.

MR. VREELAND TO REMAIN IN NEW YORK

Following the death of Charles T. Yerkes there were persistent rumors that H. H. Vreeland, president of the New York City Railway Company, had received a flattering offer from the banking interests in control of the London Underground Railways, to take up the work left by Mr. Yerkes, and that he had decided to accept the offer and go to London. It is known that several years before his death Mr. Yerkes tendered Mr. Vreeland an offer to take charge of the operation of his London roads, but this offer was declined. The rumor that Mr. Vreeland would go to London on this occasion was set at rest Jan. 3 by the announcement of the appointments, referred to elsewhere, of Edgar Speyer, of Speyer & Company, to take charge of the general financial interests of the company, and of Sir George S. Gibb of its technical operation.

Although the plans of the new company in New York have not yet been announced, it is stated, on good authority, that Mr. Vreeland will remain at the head of the Metropolitan Street Railway system. The consolidation effected last week between the Metropolitan Street Railway and the Interborough Rapid Transit interests was one which it is thought will not materially affect either operating organization. Certain improvements and economies will be effected by the consolidation, which will undoubtedly be to the advantage of the traveling public, as well as to the stockholders of both companies. It will not, however, according to those conversant with the situation, make any material change in the holdings of the interests concerned, and is, in reality, a merger of two large corporations and interests, rather than a transfer of stock from one interest to another.

The directors of the Metropolitan Securities Company have issued a call of $25 a share on the company's stock, payable on or before Jan. 30. So far, 50 per cent has been paid, and this additional call will make the stock 75 per cent paid. This step is taken in accordance with the plan for the consolidation of the Metropolitan Securities Company and the Metropolitan Street Railway Company with the Interborough Rapid Transit Company. The payment is to be made at the Morton Trust Company. As a result of its guarantee of 7 per cent dividends on the stock of the Metropolitan Street Railway Company, the Metropolitan Securities Company has run up a large debit in its profit and loss account. The call for $25 a share, it is understood, is for the purpose of settling this account in anticipation of the merger of the two traction systems. Counsel for the Metropolitan and Interborough interests are still at work on the details of the merger. They are engaged at present in the preparation of the necessary legal papers. It is said that this work will probably be completed early in January.

PERSONAL MENTION

MR. J. B. CRAWFORD has just been appointed superintendent of the Groton & Stonington Street Railway, with headquarters at Mystic, Conn.

MR. L. B. STILLWELL and MR. JOHN VAN VLECK have removed their electrical and general engineering offices to 100 Broadway, New York.

MR. HUGH WILLIAM ROSS, assistant superintendent of transportation for the Utica & Mohawk Valley Railway Company, of Utica, N. Y. is dead.

MR. JOHN LORENZ, who for the past three years has been general manager of the combined railway, light and gas properties of the Jackson Electric Railway, Light & Power Company, at Jackson, Miss., is retiring from the management of the company to become president of the Jackson, Clinton & Western Traction Company, which proposes to build an interurban line from Jackson to Clinton, a distance of 10 miles. The line is to be built on private right of way, and will carry express and baggage.

MR. SAMUEL RIDDLE has been appointed superintendent of transportation of the Rhode Island Company, to succeed Mr. A. E Potter, who has been elected general manager of the company in place of Mr. R. I. Todd, resigned, who has become general manager of the Indianapolis Traction & Terminal Company. Mr. Riddle was born in Glen Ridge, Pa., 1878, and graduated from Swarthmore College in 1897. From that time till 1904 he was connected with various engineering companies. Since 1904 he has been with the Rhode Island Company familiarizing himself with the various departments. Last year was spent by him in the transportation department, the duties of which will now devolve upon him as superintendent of transportation.

MR. A. E. POTTER, superintendent of transportation of the Rhode Island Company, of Providence, R. I., has been appointed general manager of the company, to succeed Mr. R. I. Todd, who, as previously noted in the STREET RAILWAY JOURNAL, has become general manager of the Indianapolis Traction & Terminal Company. Mr. Potter is a native of Providence, and is 33 years of age. He entered the employ of the Union Railway Company, out of which grew the Rhode Island Company, in 1892, as assistant to the superintendent of tracks. He served in this capacity until 1895, when he was appointed assistant chief conductor. In 1897 Mr. Potter was appointed superintendent of transportation, the duties of which office he was subsequently elected to perform after the Union Company was absorbed by the Rhode Island Company in 1902.

MR. JOHN W. LIEB, JR., at a meeting of the board of directors of the American Institute of Electrical Engineers on Dec. 15, was appointed trustee to represent the institute for a term of three years upon the board of trustees of the United Engineering Society, invested with the care and administration of the new United Engineering Building. Mr. Lieb at the same time was made a representative of the institute on the building committee. He succeeds Dr. Schuyler Skaats Wheeler, who by reason of his recent election to the presidency of the institute resigns from these other bodies. The representation of the institute, therefore, after the annual meeting of the United Engineering Society in January, will consist of Messrs. Charles F. Scott, Bion J. Arnold and John W. Lieb, Jr., who are past presidents of the institute in the order named. Work on the building is in active progress.

MR. HENRY C. EBERT, assistant to the third vice-president of the Westinghouse Electric & Manufacturing Company, has resigned his position to become the president of the Cincinnati Car Company and vice-president of the Ohio Traction Company. Mr. Ebert's connection with the Westinghouse Electric & Manufacturing Company dates back about fifteen years. After having been promoted to the position of superintendent of construction, which he occupied for some years, he was made chief of the correspondence department, later assistant to the manager of works, and lastly assistant to the third vice-president. It was while Mr. Ebert occupied the position of superintendent of construction that the ten 5000-hp revolving field generators made by the Westinghouse Company were installed and put in operation in the power plant of the Niagara Falls Power Company. The officers of the Westinghouse Electric & Manufacturing Company gave a dinner in his honor at the Hotel Schenley just before he left, and as a token of the esteem in which he had been held during his long association with the company, he was presented with a beautiful bronze electric stand lamp

TABLE OF OPERATING STATISTICS

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

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O.	1 m., Nov. '05	77,111	43,331	33,780	23,067	10,713
Northern Ohio Tr. & Light Co	1 " " '04	71,388	38,920	32,468	23,024	9,444
	11 " " '05	878,202	471,238	406,965	253,337	153,629
	11 " " '04	819,115	445,442	373,673	249,152	124,521
AURORA, ILL.	1 m., Oct. '05	42,375	22,976	19,399	9,333	10,065
Elgin, Aurora & Southern Tr. Co	1 " " '04	37,947	22,040	15,906	9,333	6,573
	4 " " '05	183,169	93,482	89,687	37,173	52,514
	4 " " '04	165,206	85,928	79,278	37,173	42,105
BINGHAMTON, N. Y.	1 m., Nov. '05	20,489	11,947	8,541	7,282	1,260
Binghamton Ry. Co.	1 " " '04	18,434	10,695	7,740	7,036	704
	5 " " '05	131,072	63,926	67,146	36,128	31,018
	5 " " '04	116,682	59,458	57,224	34,844	22,380
CHICAGO, ILL.	1 m., Oct. '05	58 573	30,930	27,643	------	------
Aurora, Elgin & Chicago Ry. Co	1 " " '04	42,713	21,202	21,511	------	------
	4 " " '05	268,547	128,604	139,943	------	------
	4 " " '04	201,570	97,330	104,239	------	------
Chicago & Milwaukee Elec. R. R. Co	1 m., Nov. '05	54,400	24,480	29,920	------	------
	1 " " '04	45,326	17,961	27,365	------	------
	11 " " '05	528,291	220,353	307,938	------	------
	11 " " '04	425,228	161,518	263,711	------	------
CLEVELAND, O.	1 m., Nov. '05	18,057	* 11,931	6,127	6,678	† 531
Cleveland, Painesville & Eastern R.R. Co	1 " " '04	16,710	* 11,327	5,383	6,638	†1,255
	11 " " '05	225,248	*131,126	94,121	74,031	20,090
	11 " " '04	208,658	*125,329	83,329	73,612	9,717
Cleveland & Southwestern Traction Co.	1 m., Nov. '05	46,254	25,900	20,354	------	------
	1 " " '04	41,048	22,892	18,156	------	------
	11 " " '05	495,687	287,706	207.981	------	------
	11 " " '04	438,291	271,181	167,110	------	------
DETROIT, MICH.	1 m., Nov. '05	419,299	*247,426	171,873	93,023	78,850
Detroit United Ry	1 " " '04	372,534	*212,611	159,923	90,511	69,412
	11 " " '05	4,725,292	*2798901	1,926,391	1,014,597	911,794
	11 " " '04	4,191,824	*2524402	1,667,422	982,167	685,255
DULUTH, MINN.	1 m., Nov. '05	55,154	30,597	24,556	18,171	6,385
Duluth St. Ry. Co	1 " " '04	51,925	25 553	26,372	16,521	9,851
	11 " " '05	602,333	311,906	290,427	188,349	102,078
	11 " " '04	565,461	297,931	267,530	181,505	86,025
EAST ST. LOUIS, ILL.	1 m., Nov. '05	118,218	54,670	63,548	------	------
East St. Louis & Suburban Co	1 " " 04	129,821	47,890	81.931	------	------
	11 " " '05	1,223,065	539,758	683,307	------	------
	11 " " '04	1,248,146	550,507	697,639	------	------
FT. WAYNE, IND.	1 m., Oct. '05	80,993	48,625	32,367	------	------
Ft. Wayne & Wabash Valley Tr. Co.	1 " " '04	71,884	43,774	28,110	------	------
	10 " " '05	781,697	483,577	298,120	------	------
	10 " " '04	694,862	444,347	250,515	------	------
GALVESTON, TEX.	1 m., Oct. '05	23,929	15,039	8,890	4,167	4,723
Galveston Electric Co.	1 " " '04	22,274	------	------	------	------
	6 " " '05	149,471	85,563	59,908	25,000	34,908
	6 " " '04	142,054	------	------	------	------
HANCOCK, MICH.	1 m., Oct. '05	16,540	11,422	5,118	3,753	1,365
Houghton County St. Ry. Co	1 " " '04	17,965	10,821	7,144	3,561	3,583
	12 " " '05	168,770	169,712	† 942	42,780	† 43,722
	12 " " '04	194,592	133,538	61.053	39,312	21,741
HOUSTON, TEX.	1 m., Oct. '05	46,324	27,166	19,158	9,015	10,143
Houston Electric Co.	1 " " '04	38,639	21,680	16,959	8,277	8,682
	12 " " '05	499,754	299,885	199,870	104,260	95,610
	12 " " '04	336,537	315,441	21,096	96,002	† 74,905
JACKSONVILLE, FLA.	1 m., Oct. '05	25,797	15,542	10,255	3,380	6,875
Jacksonville Elec. Co.	1 " " '04	29,359	19,957	9,402	3,017	6,385
	10 " " '05	259,595	150,559	109,036	31,140	77,896
	10 " " '04	240,680	147,236	93,445	30,766	62,679

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income Amount Available for Dividends
MILWAUKEE, WIS.	1 m., Nov. '05	278,458	127,494	150,964	78,712	72,252
Milwaukee El. Ry. & Lt. Co.	1 " " '04	275,590	132,844	142,746	77,654	65,092
	11 " " '05	2,947,791	1,412,899	1,534 892	847,930	686,962
	11 " " '04	2,932,071	1,456,150	1,475,920	834,388	641.532
Milwaukee Lt., Ht. & Tr. Co	1 m., Nov. '05	45 962	18,856	27.106	22,409	4,697
	1 " " '04	36,524	16,821	19,703	17,766	1,938
	11 " " '05	560,664	232,996	327,668	232,506	95,132
	11 " " '04	423,986	199,862	224,124	185,782	38,342
MINNEAPOLIS, MINN.	1 m., Oct. '05	420,981	192,938	228,043	103,208	124,835
Twin City R. T. Co	1 " " '04	368,057	170,238	197,819	97,308	100,511
	10 " " '05	3,903,669	1,771,088	2,132,581	1,000,217	1,132,364
	10 " " '04	3,576,229	1,680,406	1,895,823	914,441	981,382
MONTREAL, CAN.	1 m., Nov. '05	232,635	153,628	79,008	22,074	56,933
Montreal St. Ry. Co.	1 " " '04	204,555	133 849	70,706	18,871	51,835
	2 " " '05	482,424	295,309	187,115	43,137	143,978
	2 " " '04	426,831	255,486	171,345	37,818	133,527
OAKLAND, CAL.	1 m., Oct. '05	128,753	64,958	63,794	34,193	29,601
Oakland Traction Consolidated	1 " " '04	38,162	15,993	22,169	10,692	11,478
	10 " " '05	1,185,965	608,651	577,314	323,319	253,994
	10 " " '04	1,037,917	542,588	495,329	265,499	229,830
San Francisco, Oakland & San Jose Ry. Co.	1 m., Oct. '05	47,083	21,891	25,192	13,425	11,767
	1 " " '04	38,162	15,993	22,169	10,692	11,478
	10 " " '05	439,142	193,248	245,893	132,990	112,904
	10 " " '04	336,122	147,364	188,758	88,332	100,426
OLEAN, N. Y.	1 m., Oct. '05	10,440	5,584	4.856	2,570	2,285
Olean St. Ry. Co	1 " " '04	10,206	4,839	5,367	2,631	2,736
	4 " " '05	48,600	23,360	25,240	10,728	14,512
	4 " " '04	43,047	20,995	22,052	10,525	11,527
PEEKSKILL, N. Y.	1 m., Oct. '05	10,588	* 5,483	5,105	------	------
Peekskill Lighting & R R. Co	1 " " '04	9,656	------	------	------	------
	4 " " '05	46,533	* 23,171	23,363	------	------
	4 " " '04	42,772	------	------	------	------
PHILADELPHIA, PA.	1 m., Nov. '05	120,700	------	------	------	------
American Rys. Co	1 " " '04	105,754	------	------	------	------
	5 " " '05	718,433	------	------	------	------
	5 " " '04	636,187	------	------	------	------
ROCHESTER, N. Y.	1 m., Nov. '05	149,188	99,728	49,460	28,815	20,645
Rochester Ry. Co	1 " " '04	119,288	69,982	49,306	26,890	22,416
	11 " " '05	1,619,953	877,115	742,839	306,135	436,704
	11 " " '04	1,357,495	748,955	608,539	293,136	315,402
SAN FRANCISCO, CAL.	1 m., Oct. '05	638,319	------	------	------	------
United Railroads of San Francisco	1 " " '04	595,445	------	------	------	------
	10 " " '05	5,825,662	------	------	------	------
	10 " " '04	5,507,439	------	------	------	------
SAVANNAH, GA.	1 m., Oct. '05	49,907	31,752	18,155	10,642	7,513
Savannah Electric Co.	1 " " '04	48,171	26,814	21,358	10,694	10,664
	12 " " '05	575,758	341,322	234,436	126,739	107,697
	12 " " '04	540,053	304,291	235,762	125,924	109,839
SEATTLE, WASH.	1 m., Oct. '05	232,827	148,201	84,626	23,848	60,778
Seattle Electric Co	1 " " '04	203,232	136,195	67,037	25,411	41,626
	12 " " '05	2,511,607	1,669,121	842,486	295,888	546,598
	12 " " 04	2,283,516	1,580,506	703,011	284,399	418,612
TERRE HAUTE, IND.	1 m., Oct. '05	57,336	37,813	19,523	10 430	9,093
Terre Haute Tr. & Lt. Co	1 " " '04	47,405	30,128	17,277	9,319	7,958
	12 " " '05	614,617	402,638	211,980	119,445	92,535
	12 " " '04	555,065	369,129	185,937	113,459	72,478
TOLEDO, O.	1 m., Oct. '05	165,511	* 82,256	83,255	42,826	40,429
Toledo Rys. & Lt. Co.	1 " " '04	150,196	* 76,183	74,013	41,251	32,762
	10 " " '05	1,573,293	* 801,906	771,387	425,020	346,367
	10 " " '04	1,440,144	* 768,335	671,809	416,555	255,254
YOUNGSTOWN, O.	1 m., Oct. '05	46,304	* 24,288	22,016	------	------
Youngstown-Sharon Ry. & Lt. Co	1 " " '04	39,109	* 23,601	15,508	------	------
	10 " " '05	441,851	* 236,383	205,468	------	------
	10 " " '04	379,208	* 229,935	149,273	------	------