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Another Steel Car

The new steel car of the Chicago Metropolitan Elevated road, which is described elsewhere in this issue, adds another to the somewhat limited list of steel cars recently described in our columns. The steel car seems certainly to be increasing in popularity, even before it has been extensively tried in service. The desirability of steel construction has evidently taken a firm hold in the minds of the managers of a number of roads, even where freedom from fire is not as necessary as on underground lines. It is but natural that the first company operating city transportation service in this country to take up all-steel construction was the Interborough Rapid Transit Company, which operates the subway in New York. The determination to adopt all-steel cars by this company was no doubt decidedly helped along by the Paris catastrophe. On an elevated line like the Metropolitan in Chicago, the principal objects to be gained by all-steel construction are durability, freedom from loss by fire when cars are collected in yards, and freedom from panic among passengers when short-circuits occur in the car wiring when a car is in operation. As regards durability, it would seem as if riveted steel joints would be less liable to work loose in the course of years of operation than would any joints that could be made between wooden parts or between steel and wood. If the steel car is protected by paint and varnish from rusting, it should last indefinitely. As to freedom from car fire loss when cars are standing together in yards, it has been demonstrated that the possibility of such loss will justify very careful consideration of fireproof construction. As to short-circuits and consequent fires when cars are in operation, the practice already adopted by the Metropolitan before this steel car was designed of placing a continuous sheet steel floor under the regular floor and encasing all wiring in iron pipe conduits, is probably as effectual as an all-steel construction. Several other companies besides those mentioned have gone partially into steel construction, and steam roads are also seriously considering the matter. The Illinois Central suburban cars, described in our issue of April 30, 1904, approached very near to an all-steel construction.

Another notable thing about the new Metropolitan cars described is the absence of platforms and the use of sliding doors, which take the place of swinging doors or gates. These two features add to the facility of receiving and discharging passengers, and add to the seating capacity of a given length of car. In fact, when one sees the simplicity of the new arrangement which has been adopted also by the Boston Elevated, one wonders why elevated practice for so many years held to the apparently superfluous platform.

Block Signals and Train Sections

When it becomes necessary to add extra cars to take care of special traffic on a single-track interurban road, the management has a choice between two methods, either one of which has some objections from a train despatcher's standpoint. If the number of cars is increased by putting them in at intervals half way between the regular cars, the presence of so many cars on the line not called for by the regular time table is in itself an element of danger, because all employees are familiar with the regular time table, but are not familiar with whatever special cars may be put on. It usually follows, also, that the regular cars will be crowded, while the cars running on the intermediate half-hour, or whatever the interval is, will be partially empty, because many people will not be familiar with the special schedule put on for that day. Further than this, some interurban roads have not the necessary turn-outs to halve the regular interval between cars, but that is a local consideration, and not to be thought of as a sound argument against the general practice.

The other method of handling special traffic is to add as many cars operating on the time of the regular cars as may be necessary. These cars are entered on the time table as different sections of the same train. This does away with some of the time table complications spoken of, but introduces other fundamental evils. The operation of cars only two or three minutes apart, as is customary on interurban lines, where trains are run in sections, is in itself a danger because of the short interval between cars. Of course, when trains are operated in sections, employees are more on the alert than they otherwise would be, and this eliminates some of the danger. Nevertheless, as long as several cars are allowed between turn-outs at a time, there will be a chance for them to come together in a wreck. Another objection to the operation of trains in sections is the loss of time at turn-outs. If it requires from two to five minutes at each turn-out for all the sections of a train to pass, it is likely to cause a loss of time just when such loss of time is most detrimental, because of the heavy traffic on the road.

Those who look at the matter purely from the standpoint of the block signal expert, condemn unreservedly any practice which allows two cars to operate at full schedule speed within a block at the same time. Blocks need not necessarily be the length of the track between turn-outs, but in most cases that would be the length of block adopted. There is certainly a sound theory on the side of absolutely keeping trains a block apart in order to avoid collisions. Unfortunately, it is not always possible to conform to this ideal condition.

The adoption of the idea of allowing only one train at a time between turn-outs would mean either shortening the distance between turn-outs to accommodate heavy travel, or the adoption of the multiple-unit system whereby cars can be operated in trains of two or more. The latter is not an unlikely future solution of the difficulty. To be sure, the multiple-unit system is expensive, but everything considered, it would probably be the least costly method of taking care of special traffic that a road could adopt. Some roads operate trailers behind interurban motor cars, but such practice does not find general favor, for the obvious reason that it places an additional load on the motor car at the very times when it might be difficult for the motor car to maintain schedule even if it did not have a trailer attached to it. One road with which we are acquainted employs the multiple-unit system, but also sandwiches in an occasional trailer between motor cars on Sundays, when travel is extra heavy. But in this case, the Sunday schedule is slower than the regular week-day schedule, so that the cars can be kept on time.

The use of the multiple-unit system and two-car trains instead of extra cars constituting different sections of a train, has the advantage not only of safety, but a reduction in the number of extra motormen which must be kept on the list, and this is in itself desirable, not only from the standpoint of expense, but because of the decreased danger of accidents due to the elimination of the extra and less experienced men.

Armature Insulating Compounds

A subject as indefinite as any with which the master mechanic has to deal is that of insulating paints and varnishes. The appearance of the many different kinds on the market gives no clew to their insulating qualities. Any mixture, if enough lamp black be added, may appear as good as the best.

Proper testing requires so much time and attention that usually the shop man simply takes the word of the traveling representative and adopts one compound. The representative may state definitely that the compound will resist a pressure of 50,000 volts per .01 in. in thickness. No transformer capable of this pressure being at hand, all that can be done is to appear at least to believe him.

Comparative tests for ability to resist oil may be made with very little difficulty. Copper strips should be painted with the different compounds to be tested and immersed in a mixture of motor oil and water. Then gradually heat the mixture to boiling point. Some compounds will dissolve completely under this treatment. With others all the substance seems to be boiled out, leaving them hard and brittle. Others stand this test remarkably well.

At first thought it would appear that those dissolving in oil should be avoided. But it is sometimes argued that these are the best for insulation, since they contain no ingredients injurious to the cotton or linen fibre over which they are usually applied. Those dissolving in oil, it is claimed, when protected by a second coat of oil-resisting compound, make the best insulation.

The only reliable test is to treat armatures with the compounds and then keep a careful record of their behavior. It is not sufficient to apply the test to one armature alone. Several should be used, to get an average and reliable result for each compound.

Instructing the Motorman

The recent Master Mechanics' convention brought out a prolific discussion on the amount of instruction that should be given to motormen regarding the mechanical and electrical equipment of the car and as to how far motormen should be permitted or expected to go in remedying defects in equipment that arise on the road. There has always been a difference of opinion on this point, although this was not brought out at the convention. There are probably few who will maintain that it is not desirable to have motormen know as much as possible about the rolling stock under their charge. The difference of opinion occurs because many motormen must necessarily be employed who are not very familiar with the equipment, and if the policy is followed of allowing them to tamper with apparatus, they might often do more harm than good. Rules, of course, have to be made to cover the majority of cases rather than the exceptions, and if the regulations forbid motormen from attempting any kind of repairs, it must certainly be because the majority of motormen on the road are not sufficiently posted regarding the apparatus to make it wise to expect them to make these attempts. It is undoubtedly true that the older electric railways become, the better posted are the average motormen. While there will always be some men inclined to tinker with apparatus when it is not necessary, these men are the exceptions. As a general proposition, it can be laid down without any reservation whatever that the better the motormen understand the rolling stock they operate, the better it will be for the operating companies. There are certain defects which arise when an equipment is on the road that it is well that the motorman should know about and that can be remedied on very short notice. There are other defects that cannot be remedied except in the repair shop, and it certainly does no harm to have motormen well enough educated so that they will know this instead of attempting to operate a car and doing additional damage in the attempt. As a rule, motormen worth having will take some interest in getting posted about their equipment and any other points in operation, and this was a point well brought out at the convention. There will always be some indifferent men, but they belong to that class which is being continually weeded out. The sentiment shown by operating mechanical men in favor of instructing motormen, and the accounts given by the various members of how this is being done, are among the most interesting parts of the proceedings of the Master Mechanics' Association, and are among the things which will make the full reports of the proceedings of value to all members when they appear.

A Word on Car Resistances

We are in receipt of a paper on an old subject from an entirely new quarter, being an experimental study of the energy requirements on electric tramways by H. H. Fisher, of Buenos-Aires. We are wont to think of Argentina as an out-of-the-way place, but its metropolis is a fine city of considerably over half a million people, and with all the modern improvements, including a flourishing engineering society, in the "Journal" of which this paper is printed. Mr. Fisher's work was a study at first hand of the energy spent in the operation of cars, and as such is well worth considering, since in the ordinary studies on this subject there is a tendency to assume certain of the values from the results of experimenters elsewhere. Mr. Fisher separates the total car energy into four parts: first, overcoming car resistances on track, including that due to gearing; second, overcoming air resistance; third, that due to gravity resistance; and, fourth, energy of acceleration, or, as Mr. Fisher prefers to call it, energy required to replace that lost by braking. The first two elements were found by elaborate coasting experiments, many of them carried on at such low velocities that the air resistance was practically eliminated. At this point the interesting part of the study, regarding which we regret that more experimental details are not supplied, consists in a careful attempt to separate the resistance of rolling friction from that involving the axles driven by motors. This separation is involved in some difficulties which cannot be cleared up without the experimental data, but the results are interesting. The resistance for a trailer, or that part of the car weight which rests on freely rolling axles, was found to range from 2.2 lbs. to 2.9 lbs. per ton on perfectly clean and level track laid in asphalt or other first-class pavement, and so on up to as high as 11 lbs. per ton on country roads.

The resistance for motor cars with all axles driven, or for that part of the weight carried on motor-driven axles, was found to be on the best track about three times as great as the amount just given. This ratio resembles that obtained in experiments recorded elsewhere, but its real significance would take a pretty keen analysis to disclose. The vital question is the proportion of the large added resistance of a motor car which belongs purely to gearing friction, and the proportion due to miscellaneous losses in the motor when coasting or to grinding friction of the driven wheels when running. This question has never been properly investigated, and Mr. Fisher's paper emphasizes the need of further data systematically reduced. His value of the rolling friction is very low, although a low value is needed to explain some results obtained at high speed on ordinary railways. We have uniformly been a little suspicious of results deduced from coasting experiments. A carefully made set of towing experiments with a long tow rope, including a dynamometer, would go far toward clearing up the many unanswered questions regarding the nature of apparent track resistance in motor cars. For purposes of comparison, Mr. Fisher uses one of the older formulæ for air resistance, but at the low speeds considered does not find it much at variance with his experiments. From these crucial resistance questions onward, the discussion proceeds methodically along the usual lines to the calculation of the energy required. The paper then concludes with an account of some interesting tests with wattmeters, in which a prize was offered to the motormen for the most economical performance of the car on regular runs. In fifty-nine double trips of an 11-ton car, the energy consumed averaged about 750 watt-hours per car-mile, on a good track, but with some grades up to 11 per cent. The variations in the performances of different motormen ranged up to about 20 per cent above and below the figure just given, under similar conditions of traffic.

This result lays stress on the personal equation in car operating, and is in good accord with results obtained elsewhere. There is no doubt that a general installation of wattmeters on cars would accomplish a considerable reduction in the consumption of power, and those roads that have tried it have found such to be the case. A decrease of 20 per cent in the power consumption of a road means a very considerable economy, more than saving enough, in fact, to compensate for the energy used in lighting and in electric heating in a cold climate. All in all, Mr. Fisher's paper is a most creditable addition to the literature of the subject, coming from an unexpected and therefore interesting quarter. It gives an opportunity to check up some of our current data by entirely independent experiments. Anything that throws new light on the vexed questions of car resistances is welcome to street railway men, who may not be just now concerned with details regarding it, but have a keen contingent interest in the expansion of the electric railway business into fields where such data are necessary. It is a very curious thing that with all the work that is put into the solution of engineering questions, there should still be so little exact knowledge regarding so important a matter as the distribution of frictional losses in an electric motor car. The air resistance discussion which was so active a year or two ago, may now be regarded as at least temporarily closed by the results of the Zossen experiments. But the fact which confronts every electric railway engineer, that a motor-driven car systematically shows abnormally high apparent track resistance, which ought not to be capable of explanation by mere gearing friction, has as yet been given very insufficient attention. One of Mr. Fisher's remarks is worth noting in this connection. He found that a very slight inequality in the diameters of the wheels on the same axle gave added flange friction, which was painfully apparent, and that ill-fitting brakes often picked up enough dirt to increase the car resistance by more than 20 per cent. As regards the first count, it may be pertinent to ask whether any inequality in bite on the wheels of the same axle will not tend to produce a side strain sufficient to run up flange friction, and whether the driven wheels do not have a certain amount of grinding friction quite independent of any perceptible slippage? Such points as these are not particularly difficult to determine experimentally, but thus far they seem to have been rather lost in the shuffle. Perhaps Mr. Fisher himself will have a go at the problem. There is certainly plenty to be learned about the working of a simple trolley car, even now, and it will be a pity of we have to call upon a busy engineer in a city 5000 miles away or so to do the work that is needed.

AN ECONOMICAL POWER PLANT AT LIMA, OHIO

BY FRANK B. RAE

A new power plant was recently completed and has been placed in successful operation by the Lima Electric Railway & Light Company, Lima, Ohio, which for its unique and convenient arrangement of apparatus, merits careful study. It embraces the use of the latest and most modern ideas of equipment in connection with reciprocating engines, and introduces

THE NEW POWER HOUSE OF THE LIMA ELECTRIC RAILWAY & LIGHT COMPANY

a novel floor arrangement of apparatus. The plant is the result of a very careful study which has been given to all details of construction and operation, particularly in view of providing for efficient operation of auxiliary apparatus. Furthermore, the careful provisions which have been made for keeping of costs of operation are worthy of attention, as this is a feature which has too often been neglected in power plant construction; it is obvious that conditions may easily arise in a few hours which will greatly change the operating economy of a plant if there are no means of checking the same.

The Lima Electric Railway & Light Company had, previous to the installation of this new plant, been operating an old plant with a conglomerate equipment which was inconvenient and expensive in operation. This had been the natural result of the rapid growth in both its railway and electric lighting departments, additional machines having been added to the former installations as circumstances required. The service handled at the old plant included, in addition to the power circuits for the operation of the street railway system, commercial power circuits for the operation of the elevators and power motors at 250 volts on the three-wire direct-current system of distribution, from which system was also furnished considerable incandescent lighting at 120 volts. There had been installed in 1901 a 400-hp horizontal Aultman & Taylor water-tube boiler and a McIntosh-Seymour cross-compound engine direct-connected to a 300-kw General Electric three-phase generator, this constituting the most recent apparatus up to the time of the installation of the new plant. This latter unit carried a large portion of the lighting load. The remainder of the old plant involved the results of several previous years, including slide-valve engines, belted generators of several different types, tubular boilers, the old type of wood switchboard, etc. In 1902 the writer was called upon to make examination and report upon the existing plant, in order to determine its operating condition, with a view to the advisability of installing new apparatus. The report showed that for the year 1901 the cost of the output at the switchboard had been about 1.687 cents per kw-hour, which amount proved to be nearly 60 per cent of the gross receipts of the business, and thus indicated a heavy loss in power station expenses. The condition of the old plant, after careful investigation with reference to the requirements of the service handled, seemed entirely inadequate for the requirements, especially on account of lack of reserve for meeting emergencies, and accordingly an estimate was made of the cost of a new plant, to replace the old one, which should not only care for the present state of the work, but also provide for a large increase over the present output. Especial attention was paid to the possibilities of greater demand of current for the operation of the railway lines in case of the increased use of heavier cars, and also the additional operation of interurban lines.

It was proposed to construct a new power plant installation of the latest and most economical design, and, in order to reduce the machinery equipment to a minimum, to provide for an electrical distribution system by three-phase alternating current. This would have necessitated the use of rotary transformers only for the operation of the 250-volt direct-current motors, as the lighting circuits, both arc and incandescent, could all be carried upon an alternating-current system. It was considered that the present 250-volt motor circuits could be easily cared for by a temporary rotary-converter set at the station until the former direct-current motors could be gradually replaced by the induction-motor equipments.

In studying the advisability of providing for operating the engines condensing or non-condensing, it was decided, after a careful study of the advantages to be gained from the sale of exhaust steam for the heating of local buildings, to provide for non-condensing operation. A careful investigation was made of representative systems of this kind, where exhaust steam is delivered in street mains and sold to property owners, for heating of buildings, with the result that it was found particularly applicable under the conditions of operation of a city of the size of Lima. In many cities of similar size, in the Middle West, exhaust steam is sold for heating very profitably, and in an application of such a system to the conditions in question, it was found that the cost of operation of the plant could be reduced to 1.31 cents per kw-hour at the switchboard, which meant a plant expense of only about 46 per cent of the gross receipts of the year 1901. Even though the increased revenue from the sale of exhaust steam for heating were not considered, it was found that the percentage of cost of plant operation to gross receipts could be reduced nearly 14 per cent, while with the additional revenue from an exhaust steam-heating system the ratio would be much further reduced.

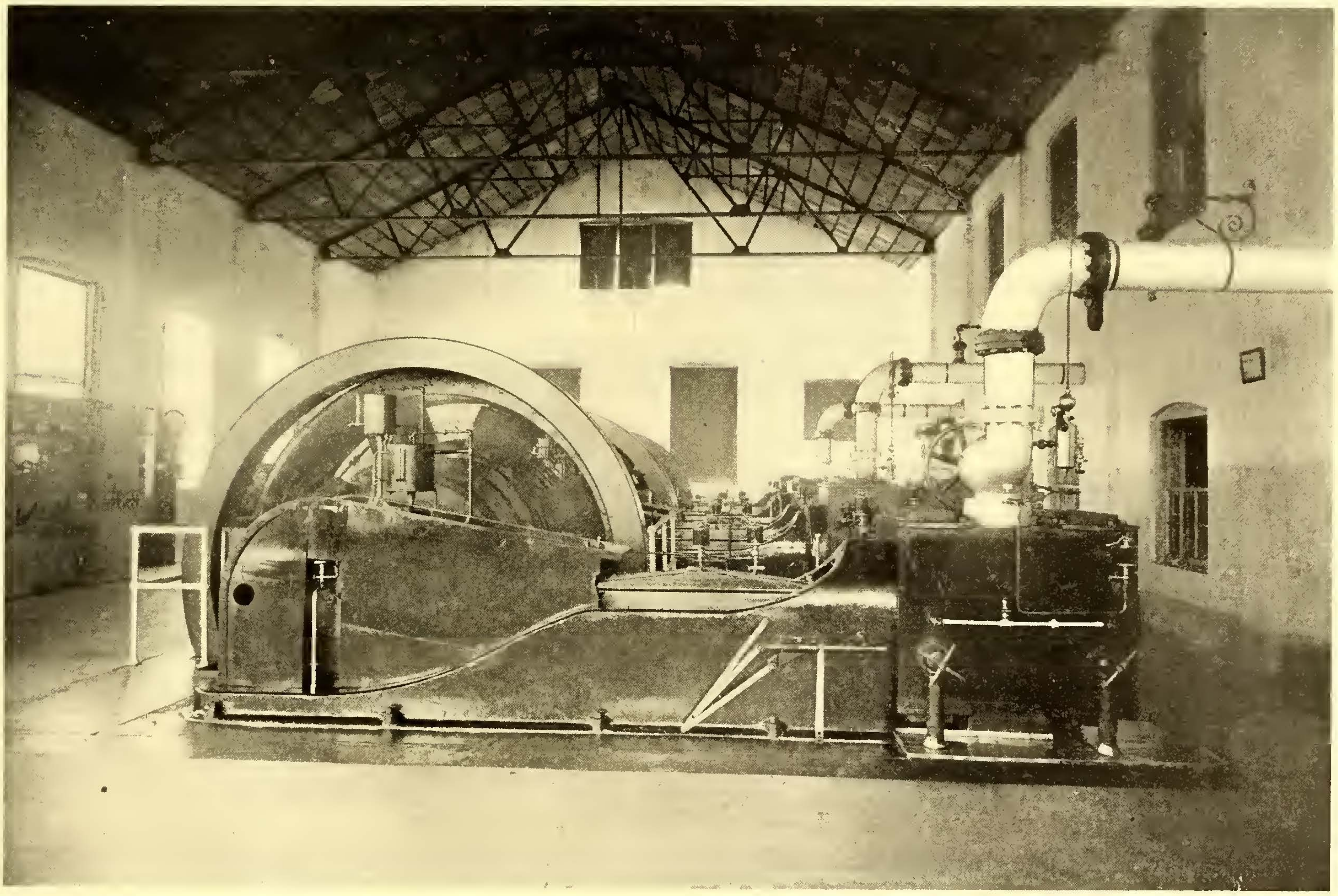
The result of a careful study of the report by the directors of the company was the authorization of an entirely new plant along the modern lines suggested by the writer, and the matter of operation of the engines was decided in favor of the non-condensing type and the exhaust steam-heating system, which eliminated the consideration of condensing equipment. Accordingly, a favorable site for the plant was chosen adjoining the Pennsylvania Railroad tracks, and plans and specifications were prepared for the erection of the building and the apparatus to be installed. On account of the above-mentioned installation in 1901 of the new boiler and direct-connected three-phase generating unit, and the further consideration that the selection of this equipment represented the best and most efficient power plant practice, it was decided to adapt the standards of the new plant to conform to this new apparatus already on hand, so that this boiler and generating unit could be retained and installed in the new plant. This determined the types of boilers, engines and generators that were used.

THE BUILDING

The design of the building is interesting in providing in a novel manner for an area between the boiler and engine rooms to contain all the auxiliary steam and motor-driven apparatus, as well as also the main steam piping systems; with this arrangement they are conveniently removed from the operating rooms, enabling special care to be devoted to them. This arrangement is shown in the accompanying cross section of the building, the boiler room appearing on the right, while the engine room is at the left. It is to be further noted that the floors are on different levels, the boiler room floor being the lowest, located at ground level, while the intermediate room is raised slightly above, and the engine room floor is at a height about 10 ft. above the ground level. This is a most convenient arrangement for the accommodation of the apparatus, and passage from one department to another is thus made in easy stages of stairways. The resulting exterior contour of the building was not rendered extraordinary, a very pleasing effect having been obtained by the architectural treatment of the facade of the intermediate room, as shown in the accompanying exterior view of the building. An unusual provision in the building is to be noted in the location of an office for the use of the chief engineer at the front of the building above the intermediate room. In this room is installed a drawing table, desk, book shelves and other provisions for the comfort and convenience of the engineer in charge of operation.

The further details of the walls, foundations and roofs of the structure are indicated in the drawings. The building has a 100-ft. front, and is 90 ft. deep. The boiler room is 36 ft. x 84 ft.; the engine room, 44 ft. x 84 ft., and the intermediate or auxiliary room, 15 ft. x 68 ft., with a stack space beyond of 15 ft. x 18 ft. The foundations are of concrete and stone of heavy design, and in all cases installed separately from the engines and generator foundations. The roofs are carried by steel roof trusses, of the types indicated, located so as to give ample head room.

The roof covering is of the latest and most approved fireproof type, having been built up of book tiles laid in between T-bar purlins and cemented in place, while the outside surface has a special roof tile covering also. This roof meets the underwriters' requirements in fireproof qualities, and is, furthermore, proof against the accumulation and dripping of condensation in cold weather—an important consideration in power plant operation. The floors are all of concrete construction, those in the engine room, where the basement construction is used, and the second floor, being carried upon corrugated metal arches between I-beams, in accordance with the usual fireproof construction; the floors of the boiler and intermediate rooms are built upon the ground filling. All doors in partition walls are also fireproof. The building contractor was Valentine Heil, of Lima, Ohio.

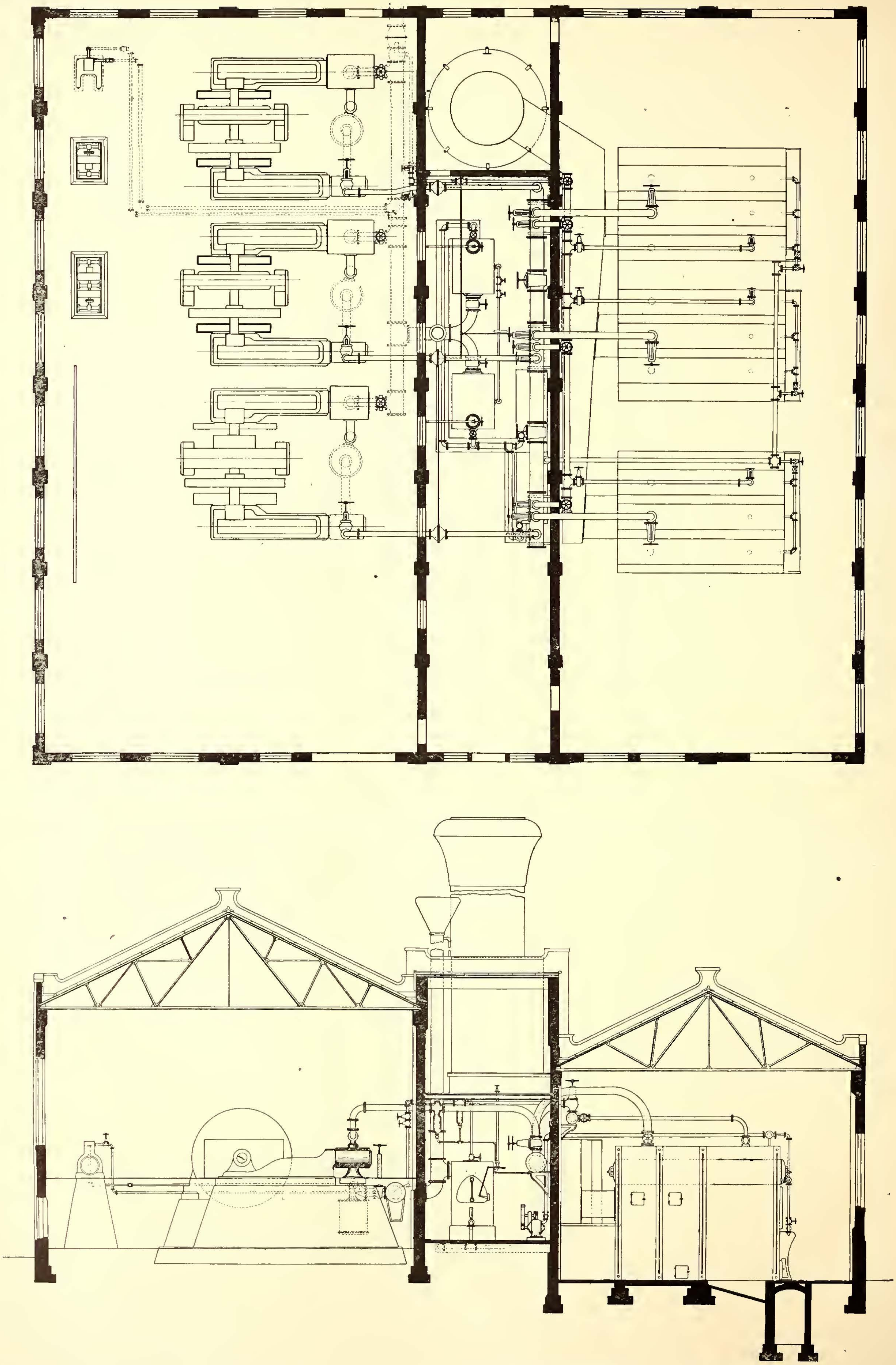


THE MAIN ENGINE ROOM OF THE NEW POWER PLANT OF THE LIMA ELECTRIC RAILWAY & LIGHT COMPANY

BOILERS

Three boilers have been installed, two in one battery and one arranged for an additional battery when the fourth shall be installed in the space provided for it at the front end of the boiler room. The boilers are of the horizontal water-tube type, each of 400-hp nominal rated capacity, and were built by the Aultman & Taylor Machinery Company, Mansfield, Ohio. Each boiler is equipped with an Acme mechanical stoker, built by Ross & Company, New York, which, as is well known, is of the inclined, rocking grate type. The ash pits are located over a special conveyor tunnel, in which operates an ash conveyor, thus facilitating the removal of ashes from beneath the boiler fronts.

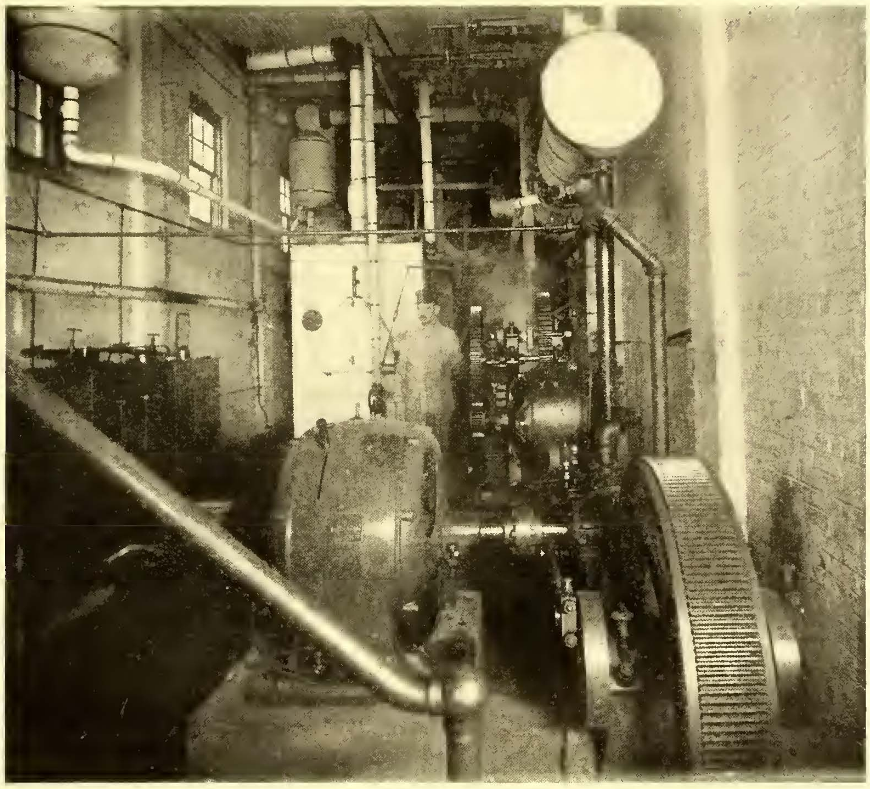
A large steel-plate flue is located at the rear of the boilers, into which the products of combustion are discharged from the



PLAN AND CROSS SECTION OF THE NEW LIMA POWER PLANT, SHOWING ARRANGEMENT OF APPARATUS AND DETAILS OF STEAM-PIPING SYSTEM boiler furnaces through short connections. This flue is covered with asbestos cement for retaining the heat, and leads directly to a self-supporting fire-brick-lined steel stack, 130 ft. high and 89 ins. inside diameter, which has its base in the rear end of the intermediate room, as shown. The stack and flue were built by E. Keeler Company, Williamsport, Pa. Each boiler-flue connection is provided with a Kellam damper regulator and Eames draft gage, furnished by James L. Robertson & Sons, New York.

THE STEAM PIPING

The steam piping installation in this plant is a model for convenience and accessibility. As may be noted from the cross section, the main header is located in the intermediate room upon a level with the engine cylinders and steam drums of the boilers. It is carried upon supporting posts, and is connected both to the steam drums of the boilers and to the engines by short and direct-connecting lines of wrought-iron pipe with easy bends. As may be further noted from the view in the intermediate room, the header valves are easy of access for the attendants for operation or adjustment. The header is 20 ins. in diameter and, extending the length of the intermediate room, serves as a valuable assistant to the boilers in the capacity of a receiver-header. It is arranged with a full equipment of valves, by which steam may be delivered through it from any boiler to any engine, each connecting branch having gate valves both at the header connection and at the boiler or engine end. In this way any boiler or engine may be cut out, if desired, or the system sectionalized.



THE INTERMEDIATE OR AUXILIARY ROOM, CONTAINING STEAM PIPING HEADER, FEED-WATER HEATERS, FEED PUMP AND OTHER AUXILIARY STEAM EQUIPMENT

Furthermore, in case of possible trouble with the header, the smaller auxiliary header located upon the boiler room side of the division wall may be pressed into service to cut around the section which is out of service; this arrangement is intended to provide against crippling the plant from any minor defect in the main header. The auxiliary header, which has a separate connection to each boiler, while normally disconnected from the main header, is ordinarily kept in service for the operation of the steam auxiliaries, being used for supplying steam to the auxiliary units, such as the pump, exciter engines, etc. Steam is delivered to the engines through Cochrane steam receiver separators, built by the Harrison Safety Boiler Works, Philadelphia, Pa. These separators are also located in the intermediate room. The piping system was furnished by the Crane Company, and installed by the local contractors. The steam pipe coverings were furnished by the H. W. Johns-Manville Company.

The exhaust steam header is located in the basement of the engine room, connections from each engine being made directly beneath the cylinders, as shown. This header leads to the rear end of the building, where connection is made, through a large Cochrane oil separator, to the street mains into which the exhaust steam of the plant is delivered in cold weather for heating. For use in weather when heating is not required, an exhaust head connection, made through the roof of the auxiliary room, as shown, permits an easy atmospheric connection. This riser is provided with a relief valve, which is adjusted to open at a pressure of from 6 lbs. to 8 lbs., so that in weather when heating is required a sufficient pressure is kept on the street mains to force the steam through the system, while any excess pressure over this amount is eased off by the automatic opening of this relief valve to the atmosphere.

Further connection is made from the exhaust main, just inside of the relief valve, to two Cochrane open feed-water heaters, built by the Harrison Safety Boiler Works, of Philadelphia, Pa., which are located in the intermediate room, as shown. These heaters take steam from the exhaust for the heating of the feed-water by induction, condensing the steam by actual contact with the feed-water. A large vent pipe connects from the upper side of the heaters to the atmosphere, to carry away the air and gases liberated from the water, and thus maintain a steady supply of steam in the heaters. Drips from the high-pressure steam headers, separators, jackets, receivers, and all others, are connected to a Holly return system, by which all the water of condensation is returned directly to the boilers, being passed through a hot-water meter, which registers the hot water thus returned. The use of steam traps is thus obviated, together with the attendant trouble and waste of condensed steam.

FEED-WATER HEATER

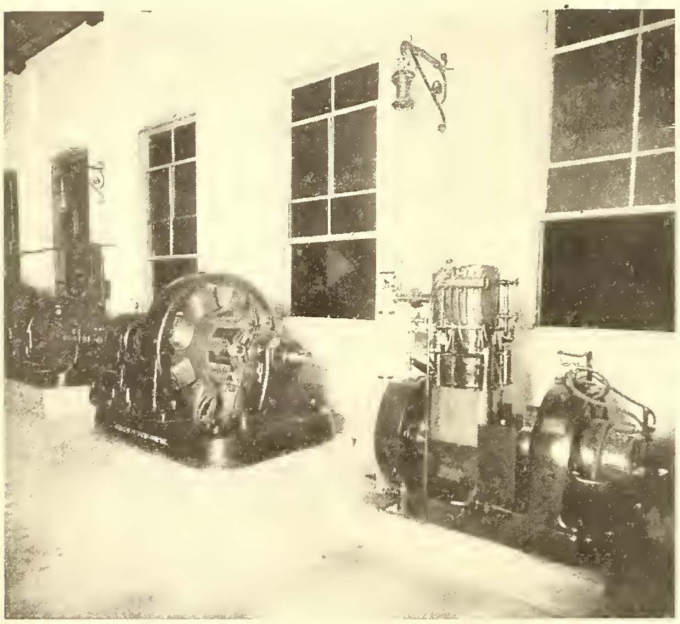
The use of the open feed-water heater and purifier in this plant is of more than usual importance, primarily on account of the fact that well water is used for boiler feeding. In the use of well water, which is so liable to be heavily charged with scale-forming impurities, it is very necessary that some means of purification should be resorted to before the passage of the water into the boilers. The open feed-water heater offers a very easy and successful solution of this problem. In it the water is brought into direct contact with the exhaust steam from the engine, which, on account of the high temperature produced, causes to be removed from it the greater part of the scale-forming impurities, by precipitation.

As above mentioned, the Cochrane open type of feed-water heater, built by the Harrison Safety Boiler Works, is used. This heater embraces in its construction an effective oil separator, by which lubricating oil entrained in the exhaust steam is effectively removed from the same before entrance into the heater, and depositing pans over which the water is caused to pass slowly, and upon which the scale may be deposited as it is precipitated by the heat of the steam. One of the important features of a feed-water heater of this type is the oil separator.

It was found, after careful investigation, that the Cochrane heater involved a separator within its construction which has shown perhaps the best results yet obtained for the removal of oil from exhaust steam.

The heaters are connected in the exhaust piping system in the manner shown in the drawings. A 2½-in. vent pipe extends from the top of each heater up several feet above the atmospheric exhaust connection, so that by a greater or less opening in the vent pipe a continuous passage of steam through the heater may be insured. This is controlled easily, according to the service, although very little attention is necessary, as the greater the demand for feed-water the greater the amount of exhaust steam that enters and condenses in heating the feed-water. It is found that the feed-water is easily maintained at a temperature of from 208 degs. to 210 degs. F.

This type of heater is the easiest to care for, as it is very easily cleaned, and on account of not being subjected to boiler pressure, does not require the maintenance that would otherwise be necessary. The supreme advantages, however, of the open type of heater are that it requires about one-sixth less exhaust steam and about one-sixth less fresh water than does a closed heater to supply the boilers with hot water; that it conserves the pure, hot condensation of the steam used in heating the water, and that it affords a degree of purification which cannot be approached by a closed heater.



THE STEAM-DRIVEN EXCITER UNIT AND THE ROTARY CONVERTER IN THE MAIN ENGINE ROOM

WATER SUPPLY

This plant is novel in that its supply of water is taken from a driven well. The well is 251 ft. deep and encased with 6-in. pipe. An ample supply of water is thereby secured, although it is rather highly charged with scale-forming impurities to be best adapted to boiler feeding. In a chemical analysis, it was found that the water contained 110 grains of total solids per gallon, calcium-sulphate and magnesium-carbonate predominating. The open heater has, however, been very effective in purifying the feed-water, so that a minimum trouble has been experienced.

The water is pumped from the well into an iron tank located in the second story of the pump room, this tank being 13½ ft. high x 11 ft. diameter, holding 10,000 gallons. The water is pumped by an "air lift," for which compressed air is supplied by a motor-driven compressor unit, supplied by the Stillwell-Bierce & Smith-Vaile Company. The tank is kept filled automatically, the motor driving the compressor by which the air lift is operated being controlled by a float in the tank, so as to set it in operation when the water level drops below a predetermined level; the float operates a Cutler-Hammer automatic motor starter. There is, of course, an auxiliary water supply connection from the city water mains, which is piped to the elevated tank for use in emergency.

The discharge from the elevated supply tank is piped to the feed-water heater, the level of the water in the heater being controlled by a gravity float mechanism which forms a part of the Cochrane heater. This float keeps a supply of highly heated water in the heater at all times for use in boiler feeding. The elevation of the supply tank is sufficient to give a head of about 10 lbs., this being necessary to overcome the back pressure in the exhaust heating system. The supply to the heater has a cold-water meter connected in it, so that the entire heater and boiler supply is metered before entering the heater, thus serving as a valuable check upon the operation of the plant.

The boiler feed-pump is a triplex motor-driven pump, built by the Laidlaw-Dunn-Gordon Company, and is located in the pump room near the feed-water heaters. This pump is driven by a General Electric direct-current motor, which is automatically controlled by the pressure in the boiler feed piping. The feed-piping system embraces a 5-in. header, in which a hot-water meter is placed, and from this header in the intermediate room are branches to each boiler, which are controlled by valves at the boiler fronts; the latter are opened and closed for feeding and shutting off, and the feed-pump acts automatically in response. When the pressure in the feed-main rises considerably above boiler pressure, the motor is shut off by an automatically-operated motor starter.

COAL AND ASH HANDLING

Coal is delivered on cars on the side track at the rear of the boiler room, and is dumped into a vertical conveyor for delivery to a coal-storage building. This storage building has a capacity for 600 tons. From this the running supply is delivered to the hoppers of the stokers by a conveyor, having an arrangement for weighing the coal as delivered.

The ashes are delivered to a drag conveyor in the tunnel, shown beneath the boiler fronts, by which they are elevated to ash bunkers at the side of the coal-storage house for dumping into carts for removal. The coal elevator and conveyors are operated by motors, and recording wattmeters on each motor show the energy taken.

ENGINES

The engine room equipment consists of three large direct-connected generating units, with provisions made for the installation of a fourth when necessary. The main engines are all of the cross-compound horizontal type, built by McIntosh, Seymour & Company, Auburn, N. Y. Two of them have cylinders 17 ins. and 28 ins. in diameter x 30-in. stroke, and are each rated at 400-hp capacity, and the other has cylinders 18 ins. and 30 ins. in diameter x 30-in. stroke, and is rated at 550 hp.

They are arranged for short direct steam connections, and are, as shown, fitted with crank cases to prevent the throwing of oil. They operate at 150 lbs. steam pressure, and are designed for non-condensing against a back pressure of 6 lbs. to 8 lbs. in the heating system. The engines driving alternating-current generators are provided with motor synchronizing attachments upon their governors, for changing speed of the engine from the switchboard.

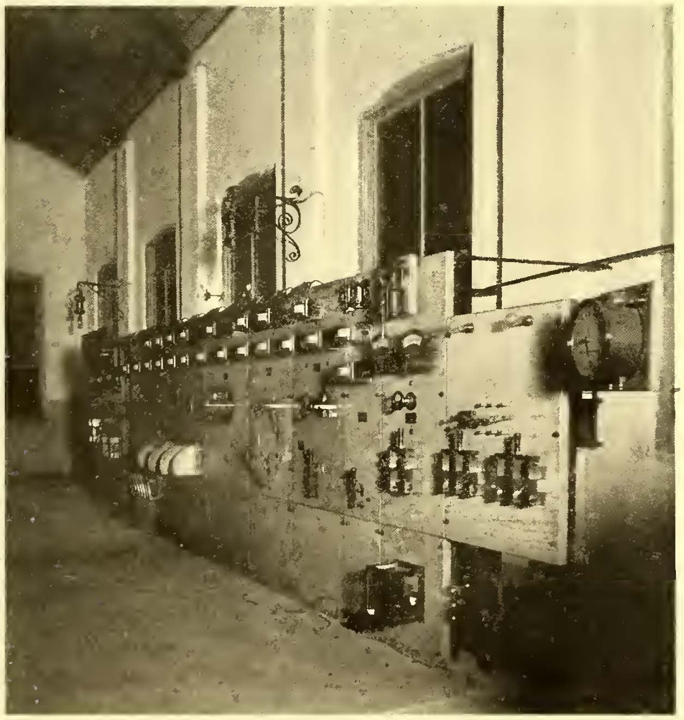
An efficient oil system was installed for handling oil for the bearings on all engines. The oil is delivered from an elevated tank, being automatically raised from a storage tank below, which is filled from barrels by a pipe from the rear of the building. The storage is in a large tank in the rear of the stack room on the main floor. Pressure is maintained on this tank from the air reservoir of the compressed-air system for the well, and the oil is thus forced to the delivery tank in the second story of the intermediate room. From these tanks it flows by gravity to all bearings, being regulated by closed sight-feed cups. The used oil is piped to filters on the floor in the intermediate room, from which, after filtering, it passes to the pressure storage tank, for use over again. Cylinder oil is similarly elevated and handled, except that it is delivered to a cylinder pump lubricator.

GENERATORS

The electrical generating equipment consists of two General Electric three-phase alternating-current units, one of 300-kw and the other of 350-kw capacity. Both deliver at 2300 volts potential, and are arranged for multiple operation. These units are excited by a 15-kw steam-engine driven exciter, delivering the exciting current at 250 volts; this is supplemented by a 150-kw rotary converter, which, in addition to exciting, will supply a 250-volt power circuit.

The other main unit is a General Electric 400-kw 500-volt direct-current railway generator, for the operation of the railway system; the latter is, in general, taken care of by this unit alone, but for emergency purposes there is a 75-kw-100-kw motor-generator set installed which will deliver 500 volts, taking current from the exciter or power circuit bus. This unit is arranged to run either way, i. e., to operate with the 75-kw 250-volt machine as a motor and delivering 550 volts for use in railway system, or to operate the 100-kw 500-volt machine as a motor and supplying the 250-volt circuit from the 75-kw side.

All excitation is thus at 250 volts, and may be had from the power bus-bars of rotary concerter or the motor-generator set, or from the steam-driven exciter. The switchboard equipment is well shown in the accompanying views. It is conveniently divided, the various circuits being arranged on different sections. The railway circuits are, as shown, located at the end of the board toward the front end of the building. The entire

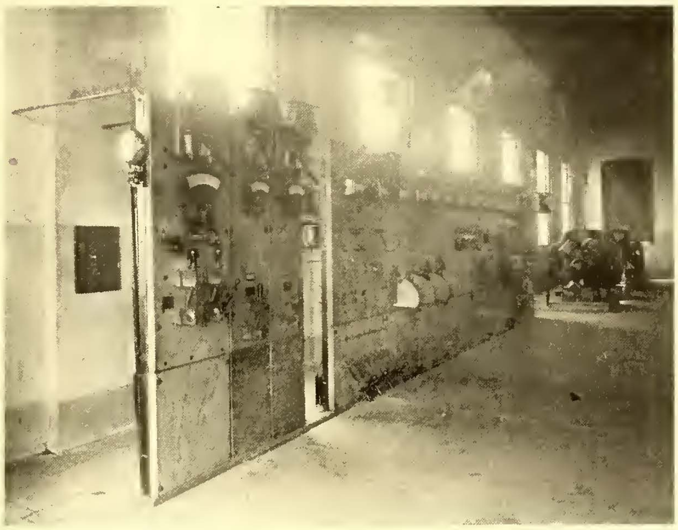


DETAIL VIEW OF THE SWITCHBOARD FROM OPPOSITE END, SHOWING ARRANGEMENT OF APPARATUS

switchboard equipment, as well as the generators, was supplied by the General Electric Company.

STATION RECORDS

The power taken on the motor-driven side of each machine in the power plant is measured by means of a recording wattmeter; this arrangement is carried out throughout the system. The measuring of all station circuits permits this local energy to be eliminated from the total output, and it accounts for much of the so-called "unaccounted for energy." The costs in this station can be checked up every day, for coal consumed, water pumped, water used, condensation returned, temperature of feed-water, total output for railway, light and power departments, watt-hours required for exciting, for running rotary, for running coal and ash machinery, for pumping, etc., etc.



VIEW OF THE SWITCHBOARD FROM THE RAILWAY FEEDER PANEL END, SHOWING MOTOR GENERATOR IN BACKGROUND.

This power station energy is thus made a part of the cost per kw-hour at the switchboard, instead of being metered in the usual manner as part of the total output, and finally appearing in the mysterious "unaccounted for current" account shown by the difference between the station and customers' meters.

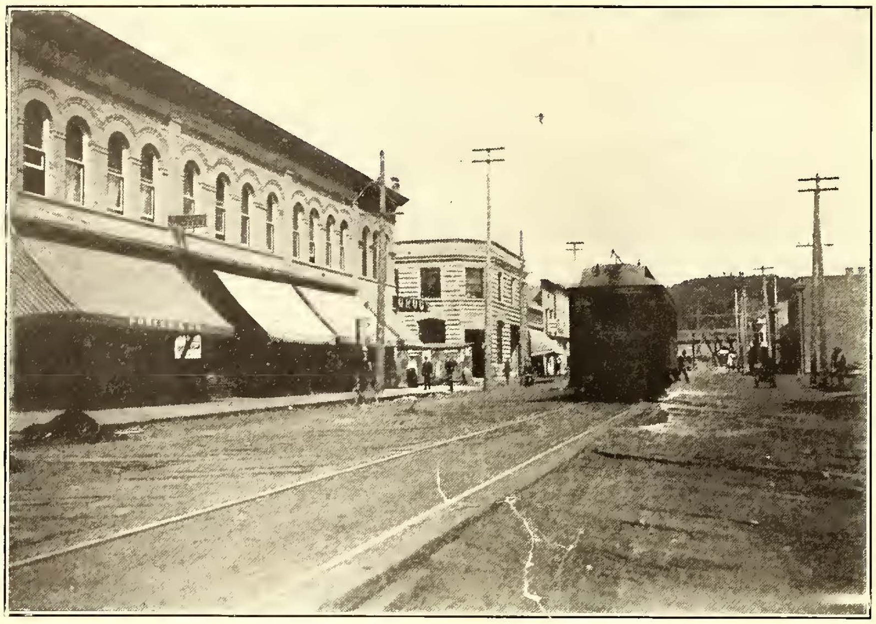
As above stated, the front of the second story over the auxiliary room is the engineer's room or office. It is very conveniently arranged with desk facilities, and also has a bath room attached. This room is provided with a cabinet drawing table for plans, etc., and the several registering meters above mentioned are located there, consisting of a recording pressure gage on the high-pressure steam header, a recording thermometer on heaters giving feed-water temperature, a recording pressure gage on the exhaust header, recording voltmeter, etc. All of the recording gages were supplied by the Bristol Company, Waterbury, Conn.

Station records are kept here, and the plant reports are made from the above instruments and the recording wattmeters. There are recording wattmeters on the alternating-current incandescent system, the direct-current 250-volt power mains, the 550-volt railway circuit and the series alternating-current arc lighting system; also on all station motors, for air-compressor motor, feed-pump motor and coal-conveyor motor.

After the new plant was completed and in full operation, the total cost was calculated carefully from the auditor's accounts, and showed the cost to have been within less than 1 per cent of the estimated cost in the original estimate. The cost of operation per kw-hour at the station, based on the first three months' operation, correcting for the difference in the price of coal due to the coal strike, was 1.66 cents, or 0.35 cents per kw-hour above the predetermined figure. This difference was found in the maintenance item, and was traced to excessive cost of boiler repairs, caused by very bad water, and other extra costs incident to starting the plant and shifting over from the old plant. Taking one of the three months separately, the cost per kw-hour at the switchboard was found to be 1.24 cents, showing that the predetermined cost of 1.31 cents was not reached during the month that excessive maintenance expense did not obtain. The predetermined cost is therefore taken to be conservative, and the designer's expectation that the plant will operate at not to exceed 1 cent per kw-hour will be realized.

THE RAILWAY BETWEEN ABERDEEN AND HOQUIAM, WASHINGTON

Aberdeen and Hoquiam are the two principal towns located on Gray's Harbor, a good sized bay off the Pacific Ocean on the western coast of Washington. The chief industry is the handling of lumber and timber products, shipments being made



A SCENE ON HERON STREET, ABERDEEN, WASH.

by rail over the Northern Pacific lines and by ship to the Pacific Coast and to foreign ports. The two towns are 4 miles apart and have an aggregate population of about 11,000, Aberdeen being the larger. Although the towns are connected by a steam railroad with two trains a day, the owners of the Gray's Harbor Electric Company, operating electric lighting stations in both places, decided that sufficient business existed or could be developed to support an electric railway service. That their decision was a wise one has been clearly demonstrated, as the road, which has been in successful operation since last March, is already paying a good interest on the investment. The property is necessarily a small one, but it is none the less interesting on that account.

Both towns are located on the edge of the bay, on rather level ground, which is of a marshy character, and is completely flooded at times of freshets and high tides. Nearly the entire length of the line, therefore, had to be filled in so as to raise the track above high-water mark. The track, which is 5½ miles long, is of standard gage, and is laid with 60-lb. 30-ft. rail on fir ties, with angle-iron joints and standard gravel ballast. The joints are bonded with Brown-Edison bonds. For a mile through the center of Aberdeen the track is carried on a low trestle so as to raise it to the height of the plank roadway. In the principal street of Hoquiam, which is also planked, the track is laid on the filled ground. In crossing the river at Hoquiam, the railway is carried over a draw-bridge, the grade of the approaches being 8 per cent. The remaining track is nearly all on the level.

The side-pole construction is used for the overhead work except on a dike embankment along the river in Hoquiam, where brackets are employed for a short distance. Forty-foot cedar poles, spaced 100 ft. apart, support the No. 00 and No. 0000 trolley wire, and carry on cross-arms the 250,000-circ. mil feeder cable and a two-phase lighting circuit. Although the accompanying pictures would not indicate it, the line in the wooded district between the two towns is laid out in the center of an 80-ft. street. The limits of the two towns adjoin, so that all the track lies within municipal boundaries.

The main power house of the Gray's Harbor Electric Company is located on the bay shore in Hoquiam. Its equipment comprises two Corliss engines, one a 26-in. x 48-in. with 18-ft. fly-wheel belted to a 150-kw direct-current railway generator and a 200-kw two-phase alternator, and the other a 24-in. x 48-in. engine belted to a 150-kw railway generator and a 150-kw two-phase alternator. Both alternators are used for supplying a commercial and municipal lighting service in Hoquiam, and a connection is also made with a lighting station in Aberdeen. The load may be thrown onto either engine, or the larger one may be connected so as to carry the entire station load, connection being made by means of a friction clutch. For emergency use a 100-kw railway generator is maintained at Aberdeen, but the railway normally is operated from the Hoquiam plant. For fuel the company uses slabs and wood refuse from the mills in Hoquiam, they being obtained at a cost which is but little greater than the expense of haulage to the boiler room.

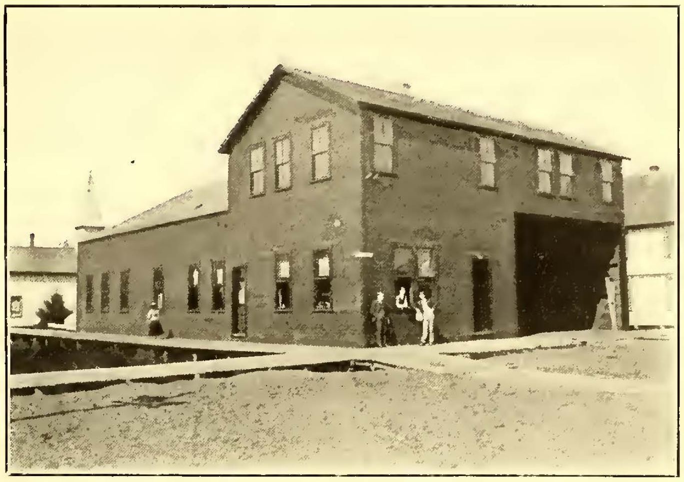
The company has two motor cars of 45-ft. and 40-ft. lengths, and one trailer. The motor cars are equipped with K-11 controllers, Westinghouse No. 56 and No. 38 motors, Christensen air brakes, manufactured by the National Electric Company, and Wagenhals arc headlights. The motor cars have baggage

PLANKED ROADWAY ON EIGHTH STREET, HOQUIAM

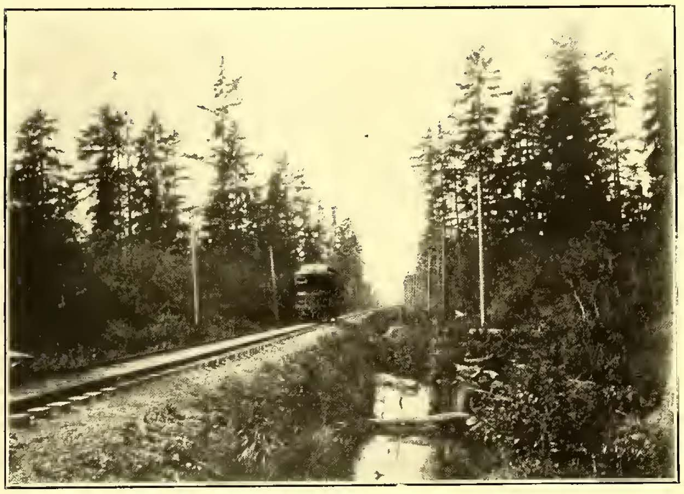
compartments, and a good business has been built up in handling light express. A track connection is made with the Northern Pacific Railroad, and considerable lumber is hauled over the electric line for steam road shipment. The repair shop, car house and general offices are located in Aberdeen.

The regular schedule of cars for passengers provides an hourly service, and a 10-cent fare is charged. Between 750 and 800 people are carried regularly each day. The record day since the road was opened up was last Fourth of July, when 4000 people were carried, the only equipment used being the two motors and one trail car.

An odd factor with which the company has to contend in the operation of its cars is the running of cows in the road. The city ordinances prohibit any but milch cows running on the streets, and allows them to be at large only until 9 p. m. No fences have been built along the track in the marshy section, and where they have been put up it has been difficult to keep them in repair. Although extra care is used in operating the cars at night, several cows have been killed. One night a steer was discovered asleep in the middle of the track and it was hit before the car could be brought to a stop, with the result that the car was ditched, blocking the traffic for about a day. The company has been seriously considering the advisability of bringing a damage suit against the owners of the steer or against the city for not enforcing the ordinance. So far the company has paid out nothing in way of claims for cows which have been killed, as it could not properly be held liable.

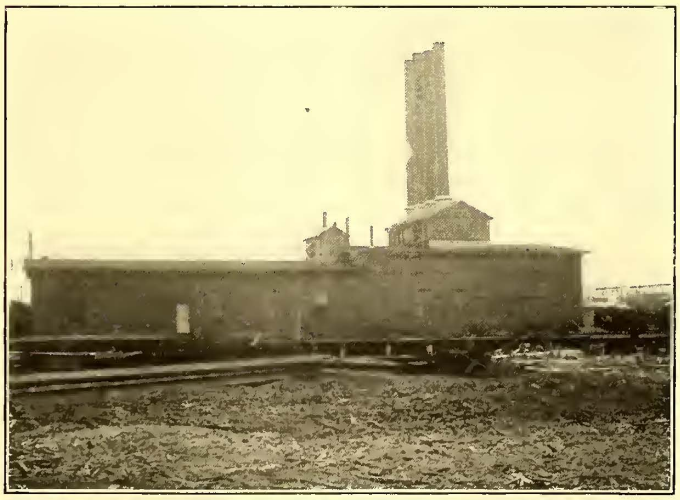


THE CAR HOUSE AND OFFICES IN ABERDEEN

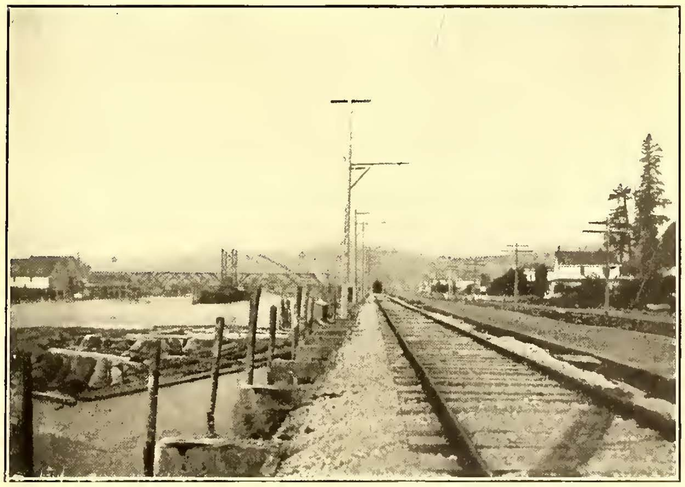


SWAMPLIKE LAND ALONG THE LINE BETWEEN ABERDEEN AND HOQUIAM

A VIEW ON THE LINE OF THE GRAY'S HARBOR ELECTRIC COMPANY, NEAR ABERDEEN



THE HOQUIAM POWER PLANT OF THE GRAY'S HARBOR ELECTRIC COMPANY



CAR RUNNING ON DIKE ALONG RIVER AND DRAWBRIDGE AT HOQUIAM

The Gray's Harbor Electric Company is capitalized at $100,000, and has the following-named officers: President, George F. Stone, Seattle; vice-president, J. B. Bridges; treasurer and general manager, Jay D. Crary; superintendent and chief engineer, E. A. Braduer. Until quite recently, George E. Moffat was general manager of the company, but upon his resignation to go East, the duties of management were placed in the hands of Mr. Crary.

The traction companies in and about Indianapolis received the election returns and telephoned the same to the conductors on outgoing and incoming trains at various points, where they were read to the passengers in the cars, much to their satisfaction and delight.

THE AUTOGRAPHIC TEST CAR

BY ALBERT B. HERRICK

The modern railway engineer needs every assistance possible in getting at the electrical condition of his property, and nowhere does this apply more forcibly than in the matter of bond testing. To take an instrument and measure the resistance of each bond separately is a laborious task. Moreover, the amount of current flowing in the rail is a necessary element of the test, and, as in ordinary operation the current is not constant and may at any time drop to zero, the individual method is of doubtful value. Again, the location by the track gang of any defective joint discovered by the bond inspector is often troublesome, due to the small number of reference points by which its position may be fixed. A car has been designed and patented by the writer to test and mark defective bonds automatically, as well as provide a complete record of the electrical condition of the return circuit. This car has already accomplished these results satisfactorily on 7000 miles of electric track, and is shown in the accompanying engravings.

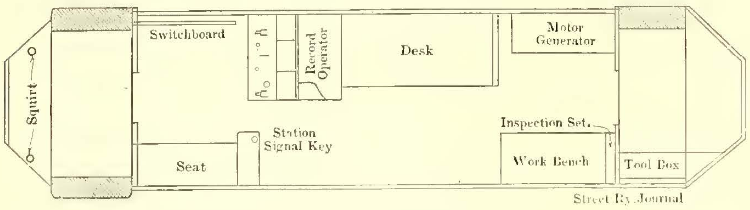


FIG. 1.—PLAN OF TEST CAR

The truck is constructed in a somewhat similar way to a trailing truck for testing bond resistances devised by the writer some years ago.* One axle is insulated from the truck frame, attached to which and close to each wheel is a metallic track brush. The car carries a motor-dynamo, 500 volts to 5 volts, and 400 amps., and a rheostat to control its speed. The current from the low potential side of this motor-dynamo is then taken to one pair of wheels, then along the rails to the other axle, which is connected to the other side of the low voltage dynamo. The direction of the current depends upon the normal flow of current in the rails, and is always made to flow in the same direction instead of in opposition to it. The voltmeters, which are connected to the track brushes already mentioned, then measure the drop in potential between the brushes on each rail.

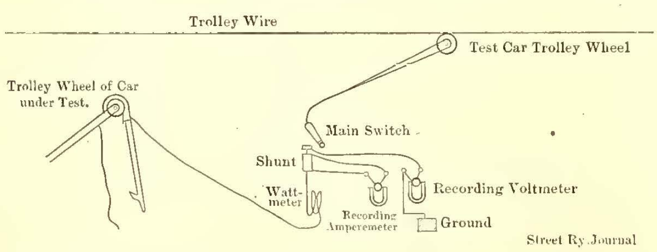


FIG. 3.—DIAGRAM OF CONNECTIONS FOR MOTOR TEST

The opposite engraving shows the interior of the new car, of which a plan is given in Fig. 1. The testing apparatus, which is mounted on a table near one end of the car, consists of two recording voltmeters and the record chart, which is moved by being belted to the axle. The voltmeters are so arranged that the movement of their hands is recorded without in any way interfering with their sensibility. This is accomplished by means of a high-tension spark which passes from a plate to the moving hand of each instrument, from which it passes to a semi-circular copper sectionalized scale under the pointer of each instrument. This scale is electrically connected to a series of terminals placed at right angles to the direction of movement of and under the record sheet, and the spark is of such a character that it burns a hole in the paper of the recording sheet as the latter moves along. In this way the circular movement of the hands is rectified and all ordinates on the record are proportional to the voltage. In some cases an ink belt is run between the spark and the paper, and with certain aniline inks the spark will carry the ink on to the record sheet.

The voltmeters are usually set for their full scale of 120 millivolts, but their shunts can be adjusted to correspond to the current flowing in the rails. For instance, the normal current in the local circuit in each rail—that is, from one wheel into the rail and back through the other wheel on the same side, and which is provided by the motor-dynamo on the test car—is 200 amps. This current is, of course, increased by the return currents of all the other cars on the system, so that the voltmeter readings depend upon the total amount of current in the rail. For this reason the voltmeters are shunted so that the full scale can be used for measuring the variations in the voltage around each joint. As a rule, each joint is measured on the record by the proportion which its resistance bears to 4 ft. of straight track. The record sheet moves 1 in. while the car progresses 100 ft., giving the bond record the scale of 1 in. to 100 ft. of track.

As the voltmeters might be injured by an excess of voltage caused by a defective bond, an automatic cut-out (see Fig. 2) is inserted in the circuit of each so that it cuts out the instrument before it can swing to full scale. This automatic cut-out is also electrically connected to a pen which makes a continuous straight line on the record when the track is in good condition, but a side dash, as shown, in the typical record sheet, Fig. 4, when the car passes any joint that has over 150 millivolts drop, or is practically open. When this automatic cut-out opens it closes another circuit which operates the valve of an air pump, by which a jet of whitewash is squirted on to the roadbed adjacent to the defective joint. In this way an open joint can be located the following day by the trackmen without reference to the autographic record, which is kept in the roadmaster's office.

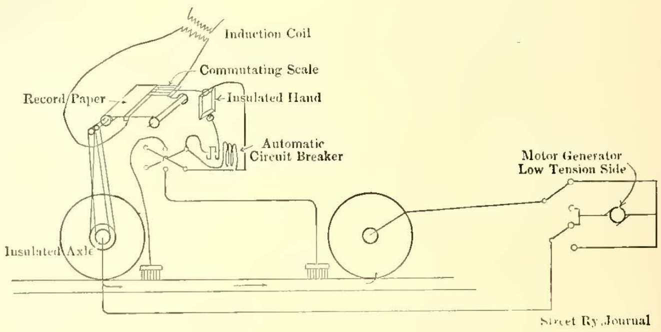


FIG. 2.—DIAGRAM OF CONNECTIONS FOR BOND TEST

The autographic record gives more information than simply the true condition of each bond. In the first place, the amount of current flowing in the rail can be determined at any instant. This is done by opening the local circuit in the car, which, as already stated, carries 200 amps. The reading of the voltmeter after opening this circuit bears the same ratio to the reading before opening the circuit that the amperes in the rail have to the original current flow.

The inductance of the rail circuit can also be very clearly determined by taking 100 amps. from the trolley wire through a resistance on the car and noting the time required on the record chart for the current to rise to the normal.

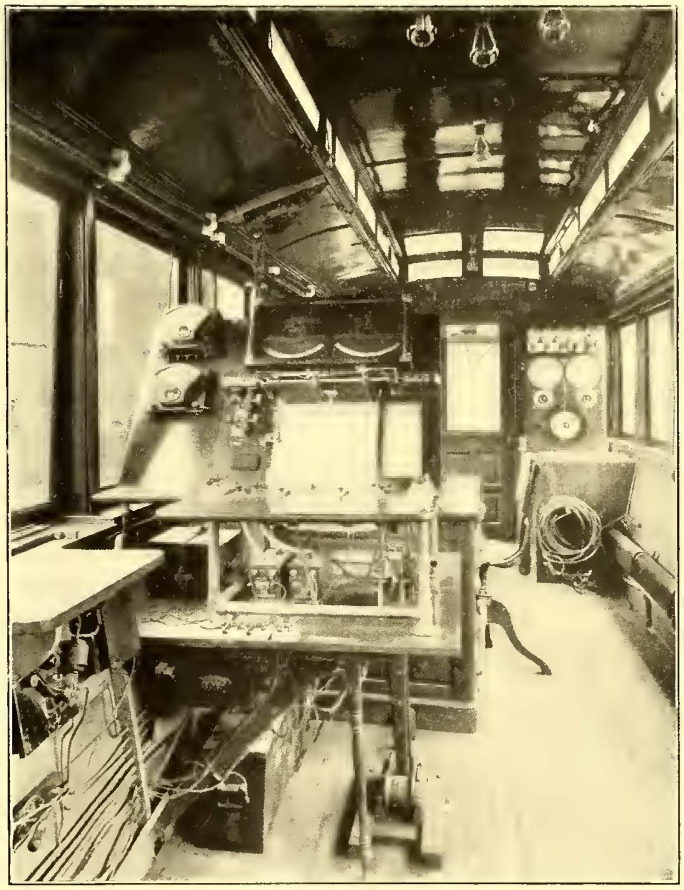
It is also easily possible to determine the total transmission losses. This is accomplished by the use of the 100-amp. circuit

* See Street Railway Journal, Feb. 3, 1900, page 126; also Herrick's "Electric Railway Hand Book," page 40.

described in the previous test, and multiplying the reading on the voltmeter by 100, to give the ohms. That is to say, since the resistance in any circuit equals the volts divided by the amperes, each volt will correspond to 1-100 ohm when the amperes are 100. Of course, if other cars are in operation, this test should be repeated until a constant or average value appears for the reading, on account of the varying voltage.

The advantage of making this test when the road is in use is that the resistance thus determined is always different and usually less than that obtained when the cars are not in operation, the reason being that poor bonding and earth leaks increase in resistance when there is no current flowing in the rails. The method described, however, gives the resistance under operating conditions, which is the proper criterion of the losses.

To determine the energy consumed by any car, the test car is attached as a trailer to a motor car whose trolley has been



GENERAL VIEW OF INTERIOR OF TEST CAR

pulled down. The motors of the cars under test are then fed through the trolley of the test car, as shown in Fig. 3, the current being lead through a wattmeter. One recording millivoltmeter is shunted around a resistance in this circuit and is calibrated to read amperes, while the other voltmeter shows the trolley wire pressure. While the motor car under test is being operated, the paper feeds through the autographic at the rate of 100 ft. of track per 1 in. of record, and as every five seconds are marked autographically on the side of the record by a clock, a complete record of the performance of the car is obtained.

The lower section of Fig. 4 is a reproduction of a typical record, as it comes off the machine, for a four-motor GE 67 equipment, operat'ng at an average speed cf 31 miles an hour. The record shows the current and voltage each instant, the actual acceleration, the performance of the equipment on each step and the resistances desirable for the best average acceleration over the route. By taking the distance traveled with current on and off, the record also shows the friction or the floating ability of this equipment. This ratio varies largely on cars of the same type over the same route, and is a valuable one to determine, as it instantly indicates defects in the equipment, such as scored axles, non-releasing brake gear, poor lubrication, etc., by comparison with similar records for other equipment of the same type. For example, the existence of short-circuited fields can be detected by the distance required for the

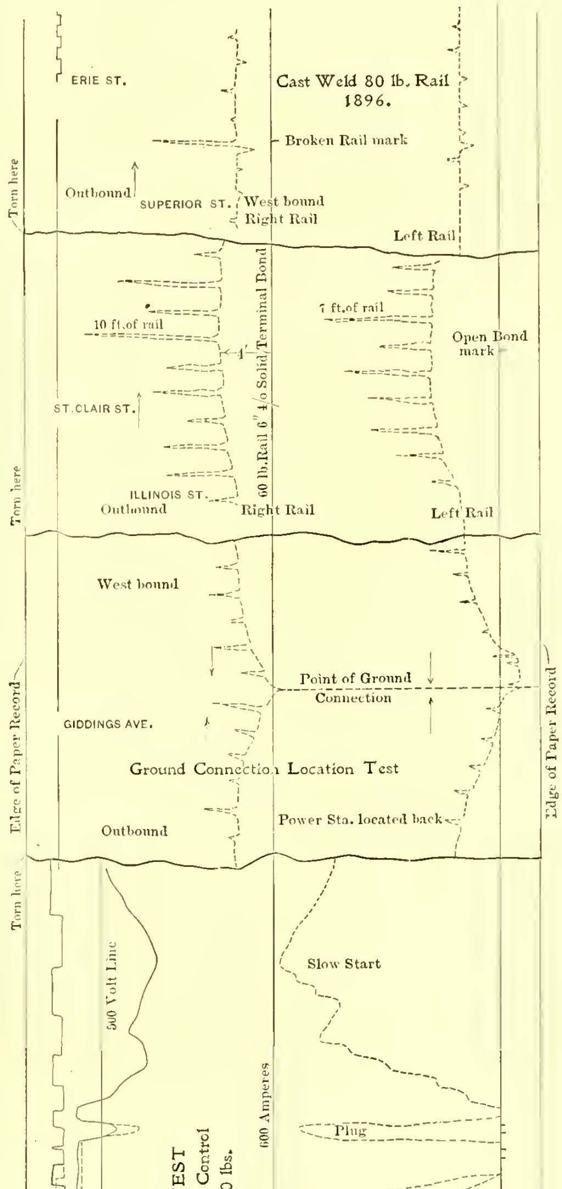


FIG. 4.—TYPICAL RECORD SHEET

equipment to gain a fixed maximum speed. Another interesting case tested, an interurban high-speed car, showed an additional consumption for the equipment under test of over 1.2 kw-hours for an 8-mile run. In investigating the cause of this additional consumption over equipments of the same type, it was found that one of the wheels was a little over 1/8 in. smaller in diameter than its fellow wheel. This showed mechanically by a thin flange, and the grinding of this pair of wheels against the side of the rail, being thrown over by the smaller wheel, increased the energy, as shown. The wheels were replaced by two wheels having the same diameter, and the performance of this car then fell in line with the other cars of the same type. In this connection it might be said that the writer has found a great difference among cars, due to the gripping and the slippage of motors. This is caused by the motors not being properly equalized and the two motors in a series position not performing equal duty. In the lower diagram of Fig. 4, B shows the current, voltage and time curves of a high friction car, and A those of a low friction car.

In the friction test the power required by the trail car is determined by an autographic dynamometer, which gives the full and mean load pull in pounds between the motor car under test and the test car, and the additional current required for the test car can be deducted, as shown, by proper calibration of the dynamometer.

Typical bond records are shown in the upper diagrams of Fig. 4. Thus poor bonds are indicated by the length of the charted lines to the left of the datum line, and in operation all which have a resistance of more than 12 ft. of adjacent rail length are squirted with whitewash. Conversely, a tendency of the return circuit lines toward the right hand side of the chart indicates a reversal of current in the rail, and if away from the power station another return path to the power station. If there are no return feeders at this point, there is probably some other ground connection, possibly through the water-pipe system or bridge structure or other system of rails.

The open bonds are shown on the datum line at the right of the track return circuit line, being marked by the automatic cut-out described in the early part of the article, and properly located through the mechanical squirt valve. A departure of the line to the left of the datum line indicates the volume of current normally flowing on this rail, plus the current supplied by the motor-dynamo.

The test car is also equipped with the writer's inspection system, which gives an analysis of the electrical condition of the car for each step of the controller, and inspects electrically the fields and armatures and other parts of the equipment.

THE VALPARAISO TRAMWAYS

About 2½ miles of single track and 2 miles of double track of the new system in Valparaiso, Chile, of the Compañia de Tranvías Eléctricos de Valparaiso, have been finished, and the company expects to have twelve cars in operation on these two sections by Jan. 1, 1905. When completed, the line will have a length of 15 miles of track and will employ sixty motor cars and forty trail cars.

Besides the electric traction plant, the company is installing cables for 30,000 16-cp lamps, as well as for the complete street lighting, which for the near future will consist of some 200 arc lamps, 700 Nernst lamps and 800 incandescent lamps of 25-cp each. The arc lamps will run nine in series, with 9 amps. between the two outers of the three-wire 2-volt x 220-volt d. c. system, and the Nernst lamps will be of ½ amp. and 1 amp. and 220 volts each.

The station is operated mainly by water-power, where 3000 hp are developed from a 900-ft. fall, which is some 6 miles from the sub-station in the center of the town. Here there is also a steam plant of two 450-hp engines, which will be used for traction and lighting purposes until the water-power plant now in construction is completed.

The officers of the company are: President, A. O. Kolkhorst; general manager, Karl Rapp.

SINGLE-PHASE ELECTRIC RAILWAY WORK IN EUROPE

In the Nov. 12 issue of the STREET RAILWAY JOURNAL a digest was published of the paper presented on single-phase railway motors at the October meeting of the New York Electrical Society by Prof. A. S. McAllister, of Cornell University. In the discussion, C. O. Mailloux, of New York, presented a very interesting account of some investigations which he had made during the past summer in Europe on alternating-current railway work. A summary of Mr. Mailloux's remarks will be found below:

The previous speakers have all dwelt upon the statement that the best single-phase alternating-current motor is substantially a motor having a series winding and a compensating winding in series therewith, or a motor which, so to speak, is practically a series motor of the direct-current type, with such slight modifications as are necessary to adapt it to an alternating-current circuit. Without stopping to discuss the question whether this is even theoretically true, I will mention the fact that the most interesting practical results thus far obtained in Europe have been with a motor which is not exactly of that kind. I refer to the Winter-Eichberg and the Latour types of motors. As Prof. McAllister has clearly pointed out, it is possible to use two magnetic fields which are in quadrature, one of which may be a series field, while the other may be either also in series or else short-circuited upon itself, or else a winding supplied with current by transformer action from the main circuit. But it is also possible to utilize the motor armature itself as a magnet, and by selecting proper points of contact on the commutator and applying brushes at these points, to send currents into the armature itself and cause it to make its own magnetic field, so to speak, and thereby produce a reacting or compensating action on the magnetic field due to the series winding proper. That is the basis of the method employed by Messrs. Winter and Eichberg, of Berlin. They obtain their compensating field by placing two brushes (called "exciting circuit brushes") at different points on the commutator of the armature, and by applying a suitable electromotive force at these points, so as to send current into the armature winding through these points, this electromotive force being obtained by some kind of transformer action. They also utilize the transformer action produced in the armature winding by the field magnetism. With this system, it is necessary to have so-called short-circuit brushes, as in the repulsion motor, so that there are two sets of brushes, one set serving to send current into the armature, and the other serving to let current come from it at certain points (situated half way between the other brushes), in order that the compensating and reactive effects desired may be produced as the resultant action of the two. There are certain practical advantages in the operation of such a motor. The so-called series-motor winding can be connected between the two poles of a circuit just as in the case of a d. c. shunt motor, or like the stator, or the equivalent field winding, of an induction motor. In fact, the term "stator" is used by Dr. Eichberg to designate the field winding of his motor. The current sent into the armature circuit, which the inventors call, in this case, the "exciting current," can be supplied in various ways—such as by a variable electromotive force obtained by means of taps from an auto-transformer, or from the secondary of a transformer taking current from the trolley line, or by a variable resistance or reactance interposed in the circuit, when the electromotive force is constant.

Although the field winding is supplied by current at constant potential, as already stated, the motor, nevertheless, in consequence of the peculiar reactions taking place in the armature (the theory of which cannot be entered into now), can be made readily to give characteristics like those of an ordinary direct-current series motor. The motor can, however, be made, just as easily. to give the characteristics of a shunt-wound direct-current motor. A motor of this kind can be controlled wholly, and very simply and easily, by merely varying the "excitation" current applied to the armature from an external source, this being done, in practice, by transformation. For series motor characteristics, a potential transformer, giving variable electromotive force, is used; for shunt motor characteristics, a current transformer has to be used. From this we can see that it is a relatively simple matter to arrange to make such a motor operate like a shunt motor at will, and, consequently, to return energy to the line on down grades or when stopping the train.

The Winter-Eichberg motors are in use on a road near Berlin, which, though very short—only about 2 km—presents great interest for many reasons, including the fact that it is the first road to be operated electrically by means of series single-phase electric motors, under commercial conditions. This road is a branch line, known as the Spindlersfeld-Niederschoenweide line, constituting part of the government steam railroad system, and was previously operated by steam. The train service is now performed by a single train, comprising two motor cars and three passenger cars, making about forty round trips, or about 160 km per day. The electric traction system was put in service in June, 1903, and at the end of the year of probation agreed upon with the government, the equipment was accepted and it is now being operated by the government.

The motor cars weigh, empty, 52 (metric) tons each. The trailer cars weigh, empty, each 12 tons. The total train of five cars, therefore, weighs, empty, about 140 tons. It weighs, when loaded, from 150 tons to 160 tons. Each motor car is equipped with two Winter-Eichberg motors. These motors are of 100 hp nominal rating, so that the nominal power per train is 400 hp.

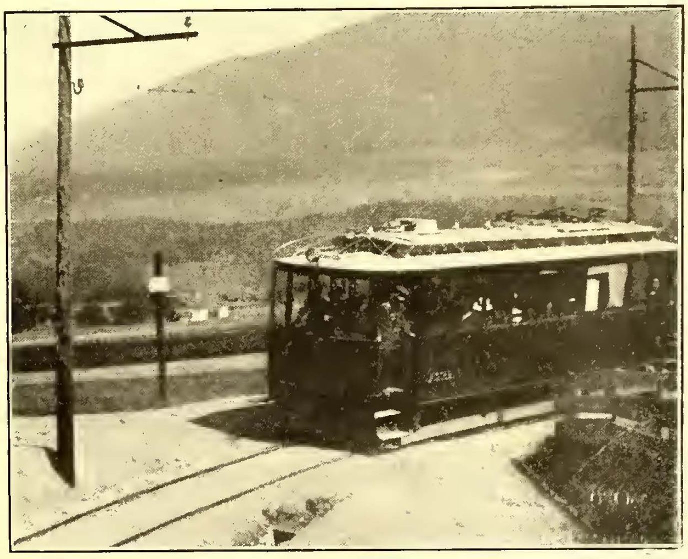
The motors are of the Winter-Eichberg type, four-poled, weighing from 1150 kg to 1200 kg. They resemble outwardly and occupy about the same space as the GE 66 motor. Dr. Eichberg informed me that they can develop a torque of about 500 m-kg. The maximum draw-bar pull per motor, with the gearing ratio in use on this line, is from 900 kg to 1000 kg, or 3600 kg to 4000 kg for the whole train. The motor cars are geared for a maximum speed of 60 km and a normal speed of 40 km to 45 km per hour. The wheels of the motor axles have a diameter of 1.8 m.

The trolley line potential is 6000 volts, the frequency of the current being 25 periods per second. The field winding is designed for a full line potential. When the motor is in circuit it is connected between the trolley line and the rails, just as if it were the stator of an induction motor or the shunt winding of a d. c. motor. The potential difference applied at the armature (through the "exciting circuit") varies from 0 to 190 volts, the electromotive force regulation being obtained by taps from the secondary of a transformer, which steps down the voltage from 6000 to 190, to furnish current for the "exciting circuit," and also for the air compressor motor, as well as for the control circuits. A multiple-unit control system is used, which is outwardly much the same as a G. E. multiple-unit control system. The control-circuit cables have ten wires. The method of control by the motorman is outwardly the same as that of an ordinary electic car. The outfit in the motorman's cab includes a regulating handle and a reversing handle, besides the air-brake valve.

The trolley line on this road is, itself, a very interesting feature, not only because it serves for such high potential (6000 volts), but because it is the first practical illustration of the so-called "catenary" trolley line. The trolley line proper forms an approximately straight line, supported by the "catenary" line by means of small vertical support wires, spaced about 3 m apart, there being ten such vertical support wires in the distance between the poles (about 39 m). The trolley wire is of copper, round, with a diameter of 8 mm (0.305 in.), and a sectional area of 53 sq. mm (92,025 circ. mils), equivalent to a size between No. 0 and No. 1 B. & S. G., which is the standard trolley wire size in Europe. The copper conductor is not subjected to great strain, the catenary or suspension wire being depended upon to hold it in place. The tension on the copper conductor does not exceed 180 kg to 200 kg. At certain points there are two catenary or suspension wires, placed at a short distance (less than 2 ft.) from each other, and both serving to support the trolley conductor; the vertical wires presenting, in this case, the appearance of a "V." The object of this double suspension is to steady the trolley conductor and prevent lateral movement.

I noted the maximum currents required during acceleration under different conditons on different points of the line as affected by the train load and the grade. The lowest readings were about 30 amps. and the highest about 38 amps. The currents observed when running at full speed ranged between 15 amps. and 20 amps.

According to tests previously made, it was found that the lowest value of the power factor during acceleration was about 0.80, the average value being from 0.82 to 0.86, and at full speed the power factor practically becomes equal to unity. The normal acceleration is about 0.3 m per second per second (0.67 miles per hour per second), but this has been increased, in tests, to more than double this value.



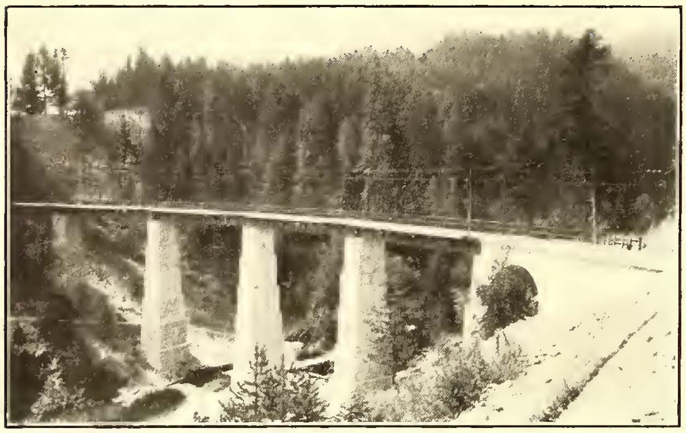
CAR AND CATENARY CONSTRUCTION—STUBAITHALBAHN

Dr. Eichberg gave, in a lecture before the Electrotechnical Society of Vienna on Dec. 23, 1903, some interesting results of a comparison between direct and alternating-current (single-phase) electric traction for this line, showing that the energy consumption is slightly lower with alternating current than it would be with direct current, the actual figures being 41 watt-hours per ton-kilometer with a power factor of 0.823 in the case of a train propelled by single-phase motors, and 43.6 watt-hours per ton-kilometer in the case of a train propelled by direct-current motors, the average velocity being 34.4 km per hour.

It is interesting to note that on the Spindlersfeld line there is only one complete train equipment. There is no reserve motor car, or even any reserve motor. When the motors need attention or repairs, a shorter train is run, with only one motor car, this being done during the week, when the traffic is not so heavy. Very little trouble has occurred thus far.

I made particular inquiries about the motor commutators, and the attendant informed me that they were examined about every month; that he had found as a result of one year's operation that they could be kept in satisfactory condition if sandpapered after running from 5000-train-km to 10,000-train-km, corresponding to a period of from five to seven weeks. The "contactors" on the multiple-unit control system had run 6000 km without receiving attention, and were still in good order on the motor car examined by me.

The same motor also figures on a very interesting road, called the Stubaithal line, in the Austrian Tyrol. This road runs from the city of Innsbruck up a mountain grade of about 2.5 per cent (with portions of 4.5 per cent) for a distance of something like 18.5 km. This road was put in operation Aug. 1, 1904, and it was visited by me Aug. 16. So far as I could ascertain, no interruptions or difficulties of any kind had occurred. The line potential is 3000 volts. As it is desirable, and as it is intended to run the same cars in the streets of Innsbruck later, the field winding has been designed for a potential varying from 450 volts to 525 volts, and the line potential (of 3000 volts) is reduced to this voltage by means of a transformer placed in the motor car. The intention is, when running in the city streets, to connect the secondary of that transformer direct with the city trolley lines, which will carry 450 volts to 525 volts. The object of this will be made clear presently. This illustrates another interesting application which can be made of that method of compensation.



BRIDGE ON CONCRETE PIERS—STUBAITHALBAHN

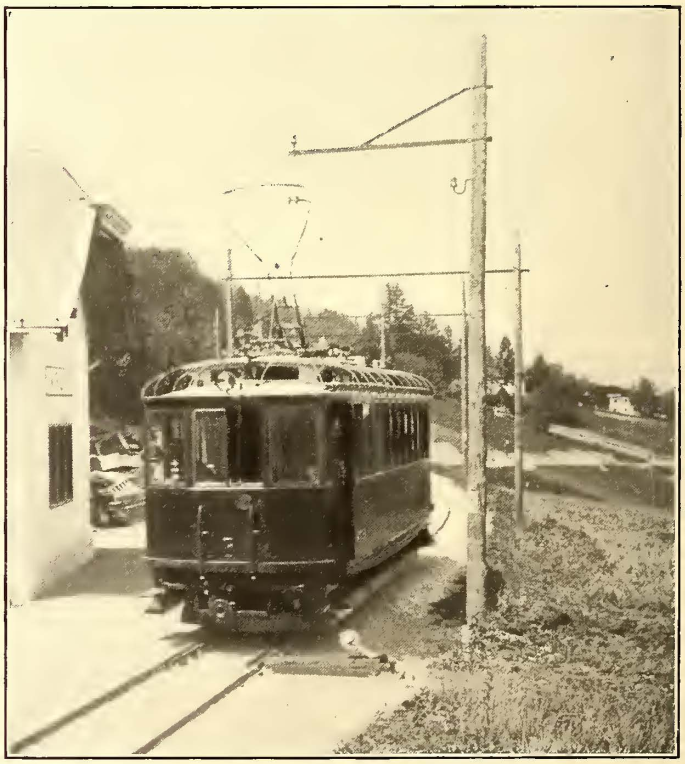
The trolley line in this case is also of the "catenary" type. The motor cars, weighing 19.6 tons, have capacity for forty passengers seated and twenty passengers standing. Each car can draw two trailers, each weighing 6.7 tons empty and about 10 tons loaded (fifty passengers each). The motor cars are each equipped with two motors, each of 40-hp nominal rating. The two "stators" (field windings) are in this case connected in multiple, while the two rotors ("exciting circuits") are connected in series. Both the stators and the rotors derive their current supply from the secondary of the transformer, which gives two voltages, namely, 500 volts between terminals and 400 volts between one terminal and a tap in the winding. The electromotive force in the exciting circuit (for the rotors) is regulated by a reactance (auto-transformer) interposed in that circuit, and having four taps connecting with the controller. The lower line potential (400 volts) is used in starting and for running at lower and moderate speeds. The higher potential (500 volts) is used for the highest speeds. It is evident that other intermediate line potentials than 400 volts could also be obtained. The object of connecting the transformer secondary between the trolley line and the rails when running in the city streets is, as we can now readily see, to utilize this secondary winding as an auto-transformer, so that the intermediate potentials (400 volts) will be then available just as when running on the high-potential line. The maximum speed allowed is 25 km per hour.. The frequency in this case is 42 periods per second. [The accompanying illustrations obtained from Mr. Mailloux show views of the motor cars and line.—Eds.]

With reference to commutator troubles, Dr. Eichberg informed me that he began with very thin carbon brushes, but has gradually increased their thickness to 10 mm. The short-circuit brushes have to carry much stronger currents than the "exciter" brushes in the Winter-Eichberg motors. For this reason their number is increased, there being four sets of short-circuit brushes and only two sets of exciter brushes.

Dr. Eichberg states that, with his motor, there is no objection to any frequency, and that the motor can just as well be designed for the usual frequencies (40 to 50 periods) in vogue in Europe. One interesting point which he mentions is that, with his motor, he would prefer to have the gearing ratio arranged so that the maximum motor speed will be about 30 per cent above synchronous speed. In this way the average speed for the entire time that the motor is running would be near synchronous speed, or only slightly above or below it, and the power factor would have the highest average value.

I ought to add that Dr. Eichberg considers his motor to be easily adaptable to direct-current lines. He expected, at the time of my second visit to Berlin, to complete arrangements, soon, for a working demonstration in which the same motors were to run partly with a. c. and partly with d. c. current, on different parts of the line.

A French electrical engineer, Marius Latour, has also devised and patented a single-phase motor, having both exciter and short-circuit brushes, approaching very closely the type just described. The French Thomson-Houston Company has built and installed several of the Latour motors for stationary purposes. Edgar W. Mix, chief engineer of this company, showed me three of these motors which form the equipment of a traveling bridge and crane, located on the Seine, and serving to unload and handle large blocks of stone building materials, etc., brought into Paris by water. These motors were submitted, in my presence, by Mr. Mix, to the most severe tests, such as throwing the regulator entirely around to the other side so as completely to reverse the polarity at full potential when running at full speed and under full load. The performance of these motors was such as to command the warmest admiration. They quickly came to a standstill, reversed, and as quickly attained speed in the other direction; the performance being repeated dozens of times, without the appearance and even, one might say, the suggestion of a spark at the commutator, whose appearance, when seen by me, would compare



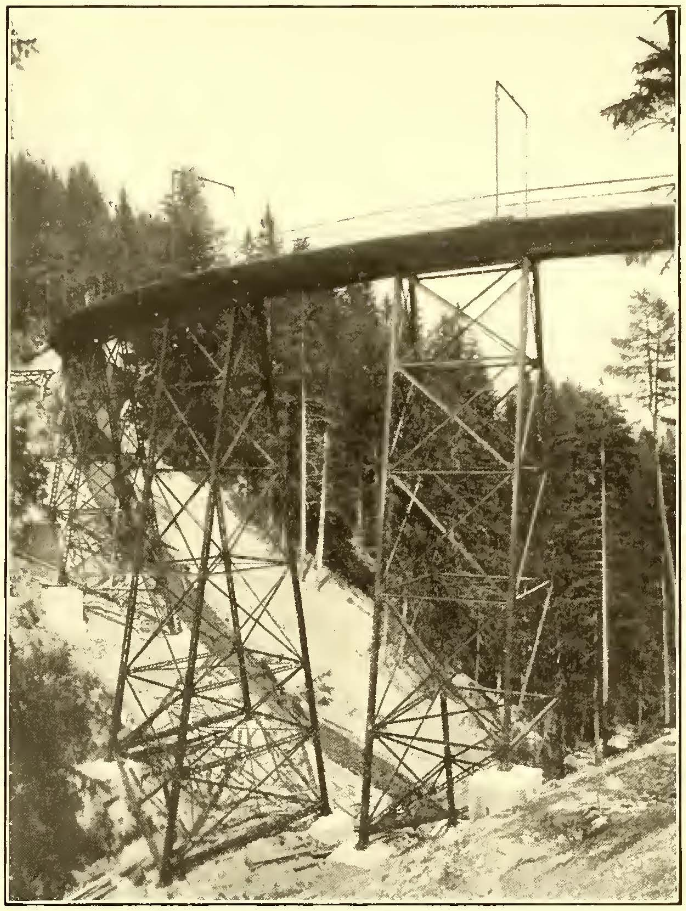
STUBAITHAL CAR, SHOWING PROTECTIVE SCREEN ON ROOF favorably with that of any direct-current commutator which has been in service an equal length of time. The largest of these motors seen by me was of 25-hp nominal rating. It was expected that some railway motors of the same type would be built in the near future.

But now, looking further than merely the electrification of urban, suburban or interurban lines, we must, of necessity, face the problem of raising the potential very much higher. I, myself, do not consider that even the catenary suspension is the happy and satisfactory solution of the problem, for I do not think that many persons entertain with very much pleasure the idea of having, directly over the cars, a line carrying anywhere from 10,000 volts to 15,000 volts, or possibly even more. Moreover, it is my opinion that for very high speeds the under-running wheel-trolley is not the ideal device. This matter has received the attention of a prominent Swiss electrical engineer, E. Huber, director and chief engineer of the Oerlikon Company, who has worked out a very ingenious solution of the problem of conveying high-potential currents to electric car motors. I had the opportunity, in Switzerland, of seeing in operation an electric locomotive built by this concern, which was supplied by a single-phase a. c. current of 15,000 volts. This equipment is intended for a very interesting demonstration of the applicability of electric traction on steam roads, which is about to be made in Switzerland by the Oerlikon Company on a little branch line passing a point near their works. This line is a part of the Swiss national railroad system, and is known as the Seebach-Wettingen line. It is about 20 km long, with single track, of standard gage. The intention, in this case, is to determine the fitness of electricity as a substitute for steam on small branch roads as a start for extending the system to larger roads, in case the results obtained on this road are satis factory. The road is at present operated by steam.

The electric train service proposed for this line will require eight trains, or four trains in each direction, per day. It is expected that this service can be done with one single electric locomotive. Each train will carry both freight and passengers, mostly freight. The estimated average total train loads, not including the weight of the locomotives, are: 180 tons to 200 tons for trains running west, in which case the up-grades average about 0.8 per cent, and 150 to 170 for trains running east, in which case the up-grades average about 1.0 per cent. The average speed will be about 40 km per hour. There are seven stations in the line, including the two terminal stations. One of the present steam locomotives will be retained in service at first, to run at least two more trains per day, one each way. This will be done partly to avoid the necessity of a second locomotive, but principally to enable the comparison between steam and electricity to be made under substantially the same operating conditions. At the time of my visit, the first electric locomotive was finished and had been in operation for several months on an experimental track extending from the works of the Oerlikon Company to the nearest point of the railroad line in question.

This first locomotive was equipped according to the so-called Leonard system, in which the motors are of the direct-current type, notwithstanding the fact that the trolley is supplied by a single-phase, alternating current, the conversion from alternating to direct current being effected by a motor-generator mounted on the locomotive. The motor-generator outfit consists of a single-phase a. c. synchronous motor, direct-coupled to and driving a direct-current generator. The generator, being driven by the synchronous motor, necessarily runs at constant speed. The speed regulation of the locomotive is easily and conveniently effected, however, by varying the field excitation of the generator, whereby the electromotive force applied to the motor terminals is varied. This locomotive was operated by means of single-phase a. c. current, having a frequency of 50 periods per second and a potential of 15,000 volts. The Oerlikon Company is at present developing a locomotive equipment consisting of single-phase a. c. motors, designed for a frequency of 15 periods. The electric locomotive is not, however, in my opinion, the most characteristic or interesting feature in this case, even though the demonstration will include working tests and experiments with two quite different types of electric locomotives. The most interesting feature is the radically new method which is to be used for conveying the electric current to the locomotive.

Mr. Huber, the inventor of the system of current conveyance, which is to be tried on this road and which has already been in experimental use for more than a year, has considered carefully, and he has tried to meet fully, all the requirements



HIGH STEEL VIADUCT NEAR KREIT-STUBAITHALBAHN

of a solution applicable to steam roads, including adaptability and reliability, under all conditions, low cost of installation and maintenance, ease of repair and, above all, freedom from danger under all circumstances. After long and diligent study of the problem, he reached the conclusion that it was necessary to depart from present methods of trolley line construction and operation. I regret the impossibility of giving you, at this time, an adequate idea of his very ingenious method, which could not be done without taking too much time, and especially without the assistance of pictures or sketches. I may, at some future date, endeavor to present a more complete description of this system, and make a more detailed reference to its features.

The word "trolley" is scarcely applicable to this system. The line from which the electric current is taken by the locomotive is called by Mr. Huber the "contact line" or "contact wire." An important and characteristic feature is that this "line" is placed on the side of the track and at a relatively low elevation, at all portions except when passing through tunnels. The trolley is replaced by a contact arm consisting of a short piece of metal tube, hinged at one end to a support attached to the roof of the locomotive, and with its free end projecting laterally and impelled by a spring so as to come against the contact line and rub against it as the locomotive moves.*

At all points, excepting near and in tunnels, the contact arm comes down over the contact wire and bears directly down on it. One of the advantages of taking the current from the contact wire *over* instead of *under* it, as in the case of the ordinary trolley line, was illustrated last winter during stormy weather; when sleet formed on the contact wire it was found that the line contact continued perfect even while icicles were hanging from the under side of the contact wire. I have photographs taken of the locomotive last winter which show these icicles on the lower side of the contact wire.

I have just referred to tunnels. To save cost of construction, the clearance allowed for between the tunnel walls and the train is usually small. On steam roads the smokestack of the locomotive, however, necessitates a relatively larger clearance above the train, and, consequently, there is more room on steam roads at the upper part than on the sides of the tunnel for the contact wire. Mr. Huber has taken this fact into consideration, and has made provision for a change of position of the contact line in passing through tunnels. An artificial tunnel with a standard European opening was built of wood over the Oerlikon experimental track at a certain point, on purpose to test this feature of the system. As the contact wire approaches the tunnel it gradually rises, and at the same time comes nearer the track to take a position over it and over the train. When the locomotive comes near the tunnel, the outer end of the hinged contact arm carried by the cab is forced upward by the rise of the contact wire, and by its displacement toward the top of the tunnel. The result is that the contact between the contact arm and the contact wire is gradually shifted from the top to the side of the contact wire, until, finally, as the locomotive enters the tunnel, the contact wire is found above the car and the contact arm is bearing against its lower surface, just like an ordinary "bow" trolley. As the locomotive passes out of the tunnel, the process is exactly reversed, and at a short distance beyond the tunnel the contact wire is again alongside the track and the contact arm is again bearing down on it from above. The average height of the contact wire in the position where it runs alongside the track and is touched from above is 4.5 m (14.8 ft.). At the points where it rises in passing from the lateral to the overhead position, its height is about 5.7 m (18.7 ft.), and inside tunnels its height is about 5 m (16.4 ft.). Inside tunnels the wire will be supported on insulators attached to the tunnel ceiling or sides, very much as an ordinary trolley wire would be. Where the contact wire runs along the track, it will be supported on insulators mounted on poles. The poles to be used in this case will be like those used for the experimental line. They consist of old iron rails set in the ground about 1.6 m deep, generally without, but sometimes with, a footing or base of concrete to give them proper stability. The distance between poles will vary between 25 m and 35 m, and it may, in some cases, be as much as 40 m. The insulator is mounted on a very simple bell-shaped support attached to the upper end of the rail.

You will readily see that since the pressure of the moving contact arm in passing over, and all strains exerted upon, the contact wire, are wholly downward, the insulator and its supports can both be of very simple, yet durable form. The contact wire is simply dropped into a slot or a clip on the top of the insulator, which itself in turn is dropped into a simple cup-like holder, or else the insulator has a support with hollowed, bell-shaped, bottom fitting over the top of the pole. There are no side arms, brackets, guys, etc., with all the weakness and disadvantages characteristic of these "trolley-line" devices. The insulator is simple, strong, and, withal, though little likely to be damaged, is very easy to replace. I saw the experiment tried of making an artificial ground at one insulator to simulate a case where the insulation breaks down and grounds the contact line. It took less than three minutes, by the watch, for a lineman to replace the "damaged" insulator by a new one and to have the current on that section of the line again. Mr. Huber has devised some very ingenious means of giving visual indication of defects in any insulator as soon as the defect occurs, so that the most inexperienced person can quickly and unmistakeably locate the defective insulator. Several different forms of such visual indicators were in use on that experimental track. The entire line will be divided into sections. The contact wires at each station will form a section, and the portion extending from one station to another will also constitute a section, so that, in all, there will be thirteen sections in the entire distance of 20 km. At any station, two adjoining sections can be entirely disconnected so as to make them both dead, this being done by means of distant ("teledynamic") switches operable from the station. Some of the advantages of a block system will thus be obtained. A fault in the line or in any insulator will cause the affected section to be disconnected automatically without grounding the contact line.

I must, for the want of time, pass by many interesting features and details of this ingenious system, but I want to add a word about cost of equipment. You will, I am sure, be interested, and perhaps surprised, to learn that the estimated cost of line equipment, including poles, contact wires, section switches, laps at sections and at stations, and also accessories of all kinds, all complete, erected and in working order, is under $1,500 per kilometer (about $2,400 per mile). You will also be interested in learning that with a current supply of 15,000 volts at one end of the line, the estimated drop at the distant end will not exceed 500 volts, or 3⅓ per cent. One of the advantages claimed for this system is that no step-down transformers will be needed even for railroad lines from 50 to 100 miles in length. In many cases the feeder line and contact wire will be the same; in other cases, for convenience, where it is desired to have the road divided into electrical blocks or sections, the contact wire will be distinct from the feeder line, but there will be no transformer between them, since the contact wire will have the same potential as the feeder line. It is expected that the Seebach-Wettingen line will be equipped and put in operation electrically before the end of this year.

I had the opportunity to see the predeterminations and the estimates of cost of equipment and of operation of a large Swiss steam railroad line—the St. Gothard tunnel line—with the Huber system. The figures showed clearly, I may say, somewhat to my surprise, that electric operation would "pay," and pay well. The estimated saving in cost of operation, if I remember rightly, was equal to over 10 per cent on the total capital investment when the cost of electrification was included, and over 15 per cent on the present capital investment, that is to say, when the cost of electrical equipment is not included. When we take into consideration the heavy grades and the heavy traffic on this line, this showing is sufficient to encourage us, as electric railroad engineers, to persist in our efforts to extend electric traction to steam lines. I speak with conviction, and after a thorough study of the Huber system, in saying that I regard it as one of the most promising recent developments in electric traction methods suited for steam roads, and one having possibilities which bring us much nearer to success than we were before. I cannot help feeling that some such method as Mr. Huber's will have to be used for conveying current to the electric locomotives or motor cars when we attempt to utilize potentials of 10,000 volts and over.

I will only mention one other point which is of considerable theoretical interest, and which may also have some practical value. It apparently has not attracted much attention in this country, though it has excited considerable discussion abroad. It is the fact that, theoretically, a series motor supplied with single-phase alternating current cannot be used so as to utilize

*This system was described and illustrated in the Street Railway Journal for April 23, 1904.—Eds.

as great a proportion of the track "adhesion," that is to say, as large a portion of the weight on the drivers, as the direct-current motor can. We all know that in the case of an insulation subjected to an alternating electromotive force, the strain upon the insulating material depends not on the average (or square root of the mean square) value, but upon the maximum value of the electromotive force, that is to say, upon the height of the maximum ordinate of the curve of electromotive force, which in the case of a sine wave is equal to $\frac{\pi}{2}$, or 1.57 times the average electromotive force value. Likewise, in the case of a single-phase alternating-current motor, there is a difference between the average torque for an entire current period, and the maximum instantaneous value of the torque, attained at some particular instant during that period. Since the torque is a sine-square function, its mean value is one-half the value of the maximum instantaneous value. Now, the tendency to make a wheel slip on the track would depend, theoretically at least, on the maximum instantaneous value of the torque developed by the motor driving the wheel, whereas the actual draw-bar pull or tractive force depends on the average or mean torque developed per electrical-current period. The practical consequence of this would be that a single-phase alternating-current motor would have less maximum "starting" power than a direct-current motor of the same rating. For motor cars or locomotives of the same weight, the wheels of the one equipped with a. c. motors should begin to slip with an average draw-bar pull equal to only about 50 per cent, or, say, not over 55 per cent or 60 per cent, of the draw-bar pull obtainable with direct-current motors, because under those conditions the maximum instantaneous value of the torque of the alternating-current motor is the same as that of the direct-current motor. This point was first raised, I think, by the engineers of Ganz & Company, of Buda-Pest, as an argument against a. c. single-phase motor traction. Experiments made by them with a brake or friction dynamometer, applied to 10-hp motors of both kinds, showed that, actually, the a. c. motor would slip when the pressure was only about 55 per cent to 60 per cent of the pressure at which the d. c. motor would slip, the results being more marked with very low frequencies than with high frequencies. At high frequencies, and also after the motors have begun to turn, even at low frequencies, the difference between alternating and direct-current motors, in this respect, disappears.

I learned before returning, that experiments to determine this difference in starting power have also been made by others, including Major Cardew, of London. The latest information is to the effect that while the phenomenon undoubtedly occurs with low frequencies (under 15 periods per second, being the more marked as frequency is reduced), it disappears with higher frequencies, and is not observable at frequencies of 25 or more periods. In all cases, the slip is the same after motion has once begun.

As a general conclusion, based on my observations in Europe, I may say that I have returned with more faith than ever in the future and possibilities of heavy electric traction, and I think that progress in its development and its extension will be much more rapid than most people now believe.

ELECTRIC RAILWAY TO TRANSPORT COAL FROM MINES

The Youngstown & Southern Railway Company has made a contract with a large coal concern to take the entire output, aggregating 1000 tons per day, of the coal from the mines opened up by the railway company near North Lima. The coal company will establish yards in Youngstown, Columbiana and other towns on the road, and the fuel will be handled by the railway company. At present the road is being operated by steam, but it will be equipped with electricity as soon as it is completed to Columbiana, so the owners say.

NOTES ON TRACK CONSTRUCTION*

BY A. N. CONNETT

The cost of city track construction varies widely, being in general from £4,000 ($20,000) to £6,000 ($30,000) per mile of single track, depending on the differences in pavement requirements. The following analysis of proportionate cost will be found a fair general average for new lines: Rails and fastenings, 22 per cent; special work, 10 per cent; paving material, 30 per cent; cement, sand and broken stone, 14 per cent; labor, 15 per cent; bonds, 2 per cent; and cartage and miscellaneous, 7 per cent.

RAILS

The report of the standardizing committee on tramway rails has greatly simplified the question of rail sections and is of advantage to both buyer and seller. The writer is not, however, an advocate of a too rigid adherence to the specifications suggested by the committee. The experts on the Continent differ from their brethren in Great Britain and the United States in that they consider that the physical tests show sufficiently whether the product is fit for its intended use, and they therefore limit themselves to such tests, leaving to the manufacturer a free hand in other respects. There is a risk that the engineer, who cannot always be expected to be an expert in metallurgy, may specify chemical requirements inconsistent with the physical tests. Again, the product may pass satisfactorily the required physical tests, but depart from specified limits in one or more comparatively unimportant elements in the chemical analysis. No particular harm should arise in any such case, if the question is left to the discretion of the engineer for decision; but a municipal engineer may regard it as his duty to bring such a matter before his committee for settlement. It is needless to say that there is not one chance in a thousand that the committee would be in any way competent to consider, let alone decide, such a question.

The result of the efforts of the standardizing committee has made improbable, for a long time to come, changes in the sections of tramway rails of the ordinary girder type. Many new types of rails have been designed and some have come into use. None of them, however, has proved superior, and it is doubtful if any have proved equal, to the ordinary well designed girder rail.

JOINTS

The question of joints is a difficult one. Where the track consists of rails laid on ties with ballasted foundation, the splice-bar joint is perfectly satisfactory. Such track is fairly comparable with that of steam railroads. If paving with sand-joints is used, it is not a very expensive matter to have access to the rail-joints when they need repairs. Such conditions exist largely in the United States. In England the paving is laid almost directly on a concrete base, upon which the rails directly rest. The conditions existing in permanent way so constructed must of necessity differ widely from those found with the elastic roadbed of a steam railway. For example, the wave-motion which is so well known in railway practice must be, if not practically absent, at least much modified with the continuous rigid foundation of a tram line. There is thus no necessity for a tramway engineer to give much consideration to the possible bad effect of unduly stiffening the joint on account of prejudicially affecting the continuity of the "wave." On the other hand, the tramway engineer has a serious condition to meet that the steam railway engineer has not, in that the rail-joint is inaccessible for inspection and repairs. This in reality is the vital difference. If joints could have the same attention that they have on steam roads, the joint problem would have

* Abstracted from a paper read before the Tramways and Light Railways Association Nov. 3.

about the same relative importance in the one case as in the other.

The properly designed splice-bar should have large area of bearing surface at top and bottom; the maximum thickness that circumstances will permit; its vertical members should be slightly convex in relation to the rail web, and a distance of from ½ in. to ⅜ in. should be left on the fishing surface of the rail top and bottom after the bars are in place to allow their taking up slight inequalities in the rolling. The bars should be at least 26 ins. long, and the bearing surface of the rail should be thoroughly cleaned of rust and scale. The bolts should be drawn up tightly with not less than a 2-ft. spanner, at the same time tapping the head with a light hammer. As a final precaution, the bolts should be gone over again in the same way just ahead of the paving work. Such joints will give excellent service if they are opened up and refixed once a year. It is not sufficient to take out a few paving blocks and to tighten up the bolts. To make the repairs anything like effective, the splice-bars should be removed as soon as there is any pounding in the joint, the bearing surfaces of bars and rails should be thoroughly cleaned, and the bars put back with the utmost care and attention. This is the reason why small boxes about the joints, which only permitted access to the bolts, were found to be of such doubtful utility. If boxes are provided, they should be designed with the object of permitting the removal and replacement of the bars. The cost of repairs to such joints, including taking out paving, refixing plates and reinstatement, should vary from 3 shillings (75 cents) to 4 shillings ($1) per joint.

Base plates are of little use unless used in conjunction with the splice-bars. A joint of this kind, known as the continuous rail-joint, has been extensively used with excellent results.

What is called the "anchor" or "bridge" joint is very largely used in Great Britain. This type of joint might with advantage be called "girder sole-plate" or "base-plate" joint, the anchoring or bridge feature being merely incidental. Usually a piece of the rail is used, though any ordinary girder section answers quite as well. Such a construction has been used on steam roads, where it was called a "crop-end" joint.' It was found to give a stiff joint, so stiff, in fact, that it was a question whether the rails did not wear more from this cause than they would have with the ordinary flexible angle-bar joint. This objection can have little weight for tram rails laid continuously on an unyielding concrete foundation. Such a joint should be of considerable assistance to prevent the initial loosening and consequent refixing, but wear will occur between the bottom of the rail and the top surface of the girder sole-plate. The experience gained by putting joints on extended yoke seats in cable railway construction demonstrated conclusively that such wear does occur. When once looseness at the joint commences, the subsequent maintenance of a good joint will depend upon the splice-bars. Whether the presence of a stiff girder sole-plate will affect the refixing of the splice-bars to get a good joint, I am unable to state, having had no personal experience to guide me.

In fixing the joint above described, it is necessary to take the precaution of careful examination of the rail heads. The slightest difference in level in the two abutting rails will cause "pounding;" the rail-ends consequently should be filed or ground off, wherever necessary, before the tracks are used for car service.

Many other forms of mechanical joints have been tried. Too many of these have some fancied advantage which necessitates sacrifice of one or more good features of the splice-bars, the net result of which is prejudicial rather than otherwise.

Mitered or beveled joints have been quite extensively tried on the Continent. If there is any advantage in these, it must be on the principle that the wheel drops into the space between the rails when the joint is square. How slight the drop is may be seen from the example of a 30-in. wheel and a ¼-in. joint, the drop in this case beng less than 1-1000 in. If joints were damaged from this cause, the rail ends should be "battered." An examination of the rail heads at worn joints will quite invariably show a bright or battered spot, an inch or more from the gap between the rails. On double track the direction of travel of the cars can be determined by the relative position of this worn or bright spot, it being found on the entering and not the leaving side of the joint. This would indicate that the wheel jumps before arriving at the gap between the rails, and that this is due to flexure at the joint. It would appear, then, that the mitering or beveling of rail ends can have no beneficial effect.

Three joints extensively used are cast, electrically welded, and thermit joints. The principal objection to the first two is the plant required. Present indications point to good results with the third joint. Personally, the writer believes in first paving the track, except around the joints, before welding, using fish-plates temporarily, and then welding the joints afterward. In this way one can overcome in the safest manner the effects of expansion due to the heating of the rails at the weld.

SPECIAL WORK

The writer then discussed special work, and recommended hardened center special work and the use of a few standard radius switches. Immediately beyond the switch, the curve can be continued into a greater or less radius, if necessary. This would be of benefit to both manufacturers and railway companies, as special work could then be made up and kept in stock.

CURVES

When single-truck cars are passing around curves, the real work in pushing the wheels laterally from the straight line direction, where they naturally roll, is performed by the front inner wheel. If the axles could assume a radial position, the wear would be slight, but the angular position of wheel and rail, which increases with the wheel base and with the sharpness of the curve, produces rubbing friction between rail and flange. If the wheel base is short, practically the whole work will be performed by the inner front wheel. With long wheel base, the rear outer wheel will do a portion of this work—i. e., the total amount of the work will be greater, but the distribution of the wear will be better. Of course, there is a limit in length of wheel base which, if exceeded, will not permit the flanges to enter the groove in the angular position of the wheel with respect to the groove. A section should be made of the proposed flange in the minimum curve, in the angular position determined by the wheel base, to see that the flange will roll in the groove. If it does not, the wheel base must be shortened, or the flange made narrower. This is not a plea for long wheel bases, but only an effort to show that, within certain well defined limits, they are not so prejudicial as is generally supposed.

In a paper recently read, it was shown that cars with maximum traction trucks have a largely increased current consumption for about the same carrying capacity car body. The statement was made that the test conditions were favorable to the double-truck cars, in that the route had an excessive amount of curvature. I believe, on the contrary, that the difference would not have been so marked on a straight route. With the double truck, the flange and rail has to overcome the friction of the center plate for pivotal trucks, and, for maximum traction trucks, the very serious side-plate friction.

The experiment above referred to was made with side-bearing maximum traction trucks against single trucks. If center pivotal trucks had been used, in all probability the difference in current consumption would not have been so great. I know of an instance where single and maximum traction trucks are used, and where the wear of flanges and curve rails is excessive. This is attributed to the single trucks because the wheel base is 7 ft. I believe, on the contrary, that the maximum traction trucks are the worst offenders.

Theoretically, the flange pressure to overcome center or side-plate friction on double trucks only takes place on entering and leaving the curve, assuming that this is not compounded. The trucks not being absolutely rigid, there is some "give" in them, and consequently flange pressure from this cause will exist all through the curve, though, of course, to a much greater degree at the two ends. To sum up, one cannot assume a minimum rail and flange wear with double trucks, especially of the side-bearing maximum traction type.

Previous to the introduction of the standard types, most of the curve rails had vertical sides to the lip or guard. Consequently the wear of the lip and flange was very rapid until the angle of wear (12 degs. to 16 degs.) was reached. Unfortunately, there was then very little lip left, and renewals were consequently unnecessarily rapid. With the standard type of curve rails much better results will be obtained. Perhaps, in the near future, curve rails will be rolled of a more suitable material, say nickel steel.

CONSTRUCTION

As already stated, the concrete type of construction is, and in all probability will remain, the standard in Great Britain. There are two ways of setting the rails on the concrete, each of which has its partisans. In one case the concrete is laid to within, say, an inch of the proper surface for the base of the rail, and the rails are then laid on the concrete and surfaced by blocks or wedges. The space between the base of the rail and the top of the concrete is packed in with fine concrete. The principal disadvantage of this method is that the surfacing of the rails to the required levels may diminish the packing space to such an extent that only a very thin skin of fine concrete can be placed between the base of the rail and the foundation, properly speaking. The vibratory action of the rails due to the car traffic, may crack, pulverize or otherwise injure this thin layer of concrete or mortar. The other way is to block up the rails to the required levels first, and then place the concrete in one operation. To do this the concrete needs to be made rather wet, so that it will have the characteristics of a quaking mass. The concrete should also be carried up beyond the base of the rails on each side, and worked well under the rails, and then all smoothed off with the shovel before it is set. If the work is properly done, this method should give the better result.

Great care should be exercised that the foundation on which the concrete rests is sufficient to properly carry the cars and regular street vehicular traffic. If the foundation is insufficient there will be settlements of the concrete, and consequent damage to the work. It is a trying problem to the engineer to know just what to do in case the sub-soil looks at all treacherous. Additional depths of concrete will answer in some cases where the settlements are not uniform, but in small pockets. The concrete in this case will act as a bridge or an arch to carry the load over the weak spots. In case uniform settlement is to be expected, a tie construction would be the safest. This would be on the principle that there will be a settlement, and that the cheapest means of resurfacing the track one or more times until all the settlements have taken place will be to lift the rails and ties and repack under the latter. In this case, of course, concrete between the ties for paving foundations would be inadvisable. Broken stone ballast would be the best for temporary purposes until all settlement had taken place, and then finally the whole could be permanently concreted. If a concrete foundation is required at first it might be practical to use ferro-concrete under and beyond the track for the purpose of increasing the bearing surface of the track without using a prohibitive depth of concrete. Fortunately, such cases are comparatively rare, and when they are met there must be some extraordinary means taken to prevent settlement and consequent damage to the work, or, on the other hand, to recognize that this will occur and design the roadbed so that the repairs can be made later at a minimum cost.

Many are familiar with the novel type of construction used at Hull, in which the rails were laid on concrete, but between the base of the rail and the concrete was a creosoted Baltic redwood stringer 4 ins. deep and 7 ins. wide, to provide elasticity, and consequently a less noisy and perhaps easier riding track. The rail used has a center groove, and the wheel has two treads and a center flange. The joints are mitered to an angle of 45 degs. The engineer of this line, Mr. White, writes "that comparatively little trouble has been experienced with the rail-joints, and the rhythmic hammering of the car wheel as it passes over the joint is not heard on the Hull system in the same way as in most other systems which have been in operation for any length of time with ordinary joints. The two routes first constructed have now been running for over five years, and, until during the last few months, the rail-joints have had practically no attention. We are now, however, having them all tried over with a straight edge, and all joints which are in any way loose, or show a depression of more than 1-16 in. on a 5-ft. stretch with the straight edge, are being opened out, packed where required, and tightened up." Mr. White further points out that, making due allowance for extraordinary expenses connected with the maintenance of the permanent way, there is left a sum of £700 for ordinary maintenance. This for a car mileage of 2,500,000 makes an expense of .067 pence (.134 cents) per car-mile, which is only about one-quarter of that usually found on tram lines that have been running for this period, which is certainly very satisfactory. Personally, I believe that this result is in a great measure due to the care which must have been exercised originally in the construction of the lines, and that the special features of the construction if contributory to the good results are only so in a minor degree.

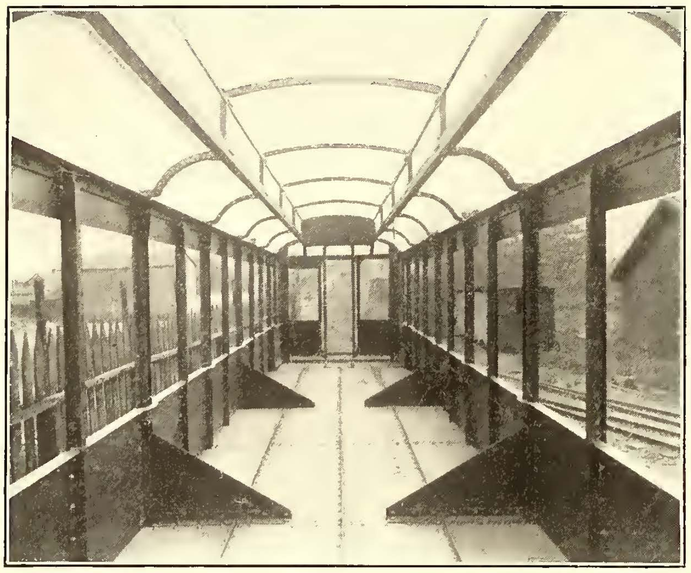
There is a very marked tendency in permanent way construction now to anchor firmly the rails to the concrete bed. The object of this is to prevent the working of the rails under the rolling action of the cars. The principal disadvantage in the vertical motion of the rails is to produce a joint between the abutting paving and the rails. Whether anchoring will prevent this, and, if so, what form of anchors should be used, and the requisite spacing, will have to be determined by experience. There is one thing that is quite evident, viz., that the amount of movement is slight, and that any anchor which allows the slightest play between it and the rail, or between it and the concrete, will not be efficient.

A peculiar accident occurred on the Columbus, Newark & Zanesville Railway recently. A short distance out of Zanesville the line crosses a long trestle over the Licking River. A lady who lived a short distance from the trestle on the Zanesville side asked the conductor on paying her fare to let her off at the stop before the bridge. For some reason or other the car ran beyond the stopping point and came to a stop on the bridge, the motorman evidently intending to back up to the station. The conductor was forward in the smoking compartment when the car came to a stop, and started back to help the lady alight, as it was a dark night. He found to his horror that she was not on the platform, although he had seen her leave her seat. Investigation showed that she had stepped from the car, fallen into the river 60 ft. below, and had been killed instantly. The officials of the company claim that the woman alighted from the car while it was in motion and before she had been notified that her station had been reached.

The New Orleans Railways Company is operating a new line of cars known as the "Camp Street Route," which relieves the congestion of the Magazine and Coliseum lines. The extra cars are operated on the tracks of the Magazine line up Camp Street into Magazine as far as the Arabella car house, which is the terminus, and down Magazine into Camp to Canal Street.

ALL-STEEL CAR FOR THE METROPOLITAN ELEVATED, CHICAGO

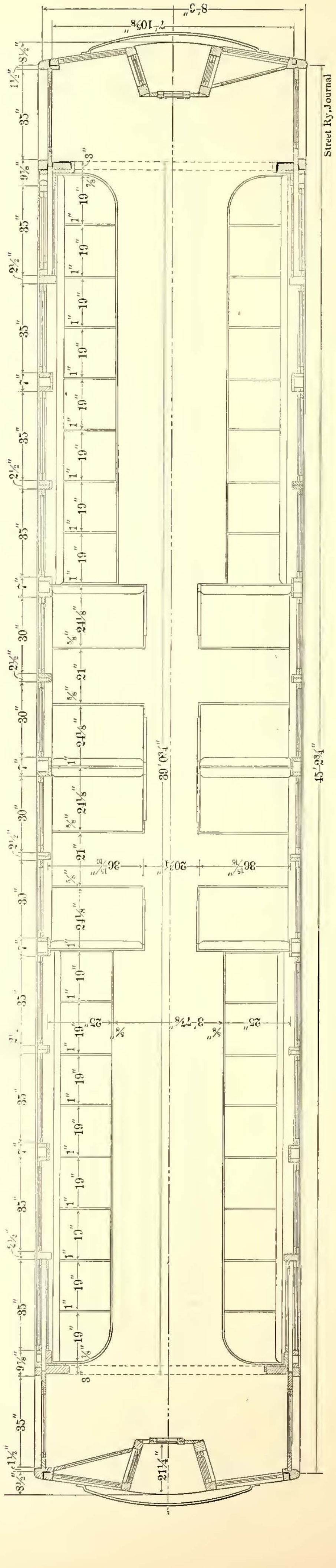
In view of the present interest in all-steel passenger car construction, the accompanying illustrations and description of the new all-steel car being built at the Jeffersonville, Ind., shops of the American Car & Foundry Company for the Metropolitan West Side Elevated Railway Company, of Chicago, are most timely. This car is of the same general form as other cars recently ordered by that company. The seating arrangement is shown in one of the accompanying engravings, and also the general dimensions of the car. The car has no platforms, and sliding doors are placed directly in the corners of the car. These doors slide back into the side of the car. There is a niche where the guard stands when operating the gates at stations, this niche being outside the car. The general arrangement is similar to that used on the new Boston elevated cars, save that the Boston cars have not the niche for the guard to stand outside of the car.



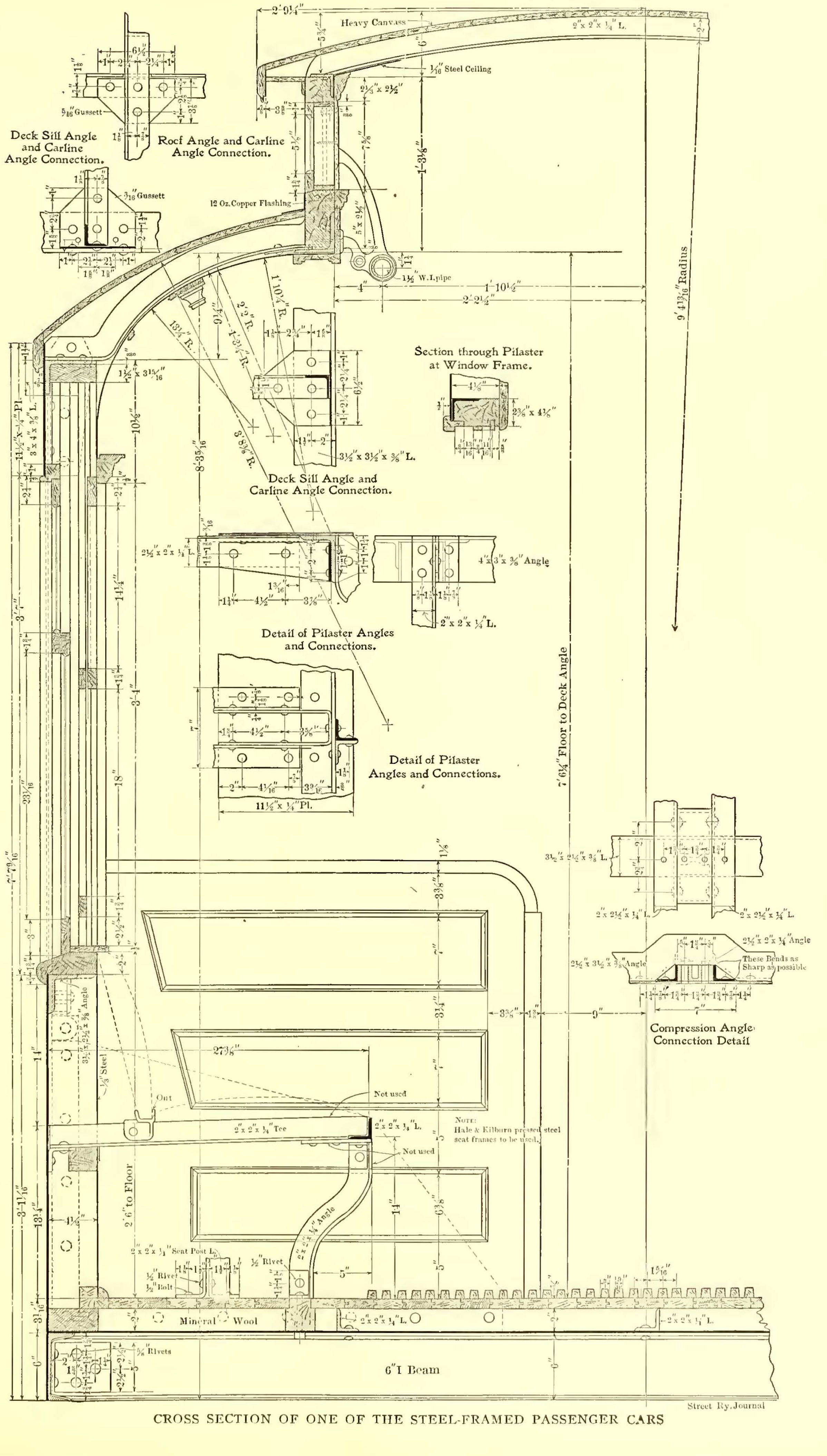
VIEW OF CAR INTERIOR, SHOWING PLATE GIRDERS, SIDE SILLS, CARLINES AND SHEET STEEL BOTTOM

END VIEW OF ALL-STEEL CAR, SHOWING SPACE IN CORNER FOR SLIDING SIDE DOORS

A section through one-half of the all-steel car is shown in one of the accompanying drawings. The sides, from the window sills down to the bottom of the side sills, are covered with ¼-in. steel plate, continuous from end to end of the car, this

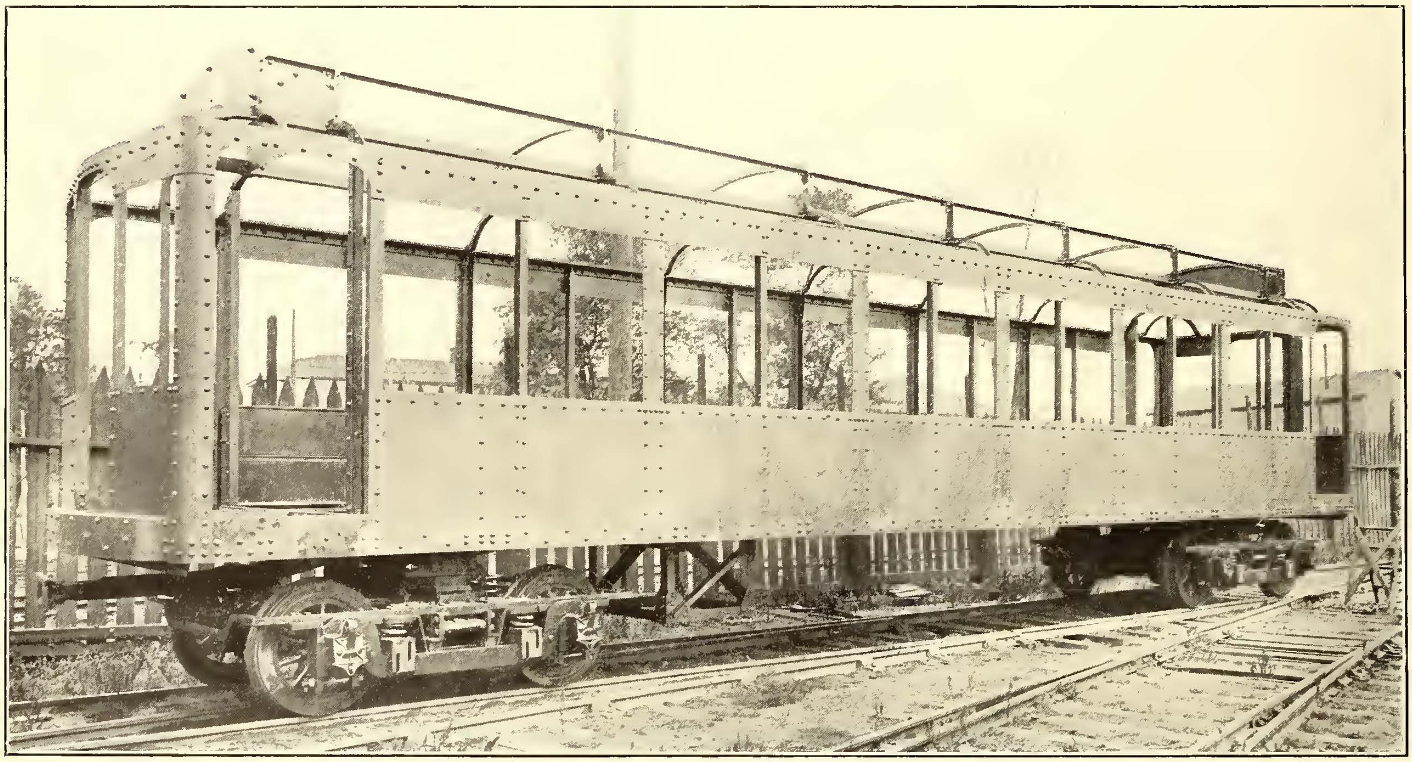


FLOOR PLAN OF ALL-STEEL CAR FOR THE METROPOLITAN ELEVATED RAILROAD, OF CHICAGO, SHOWING THE SEATING ARRANGEMENT AND POSITION OF THE DOORS



CROSS SECTION OF ONE OF THE STEEL-FRAMED PASSENGER CARS plate being riveted to a 6-in. channel-bar, which forms the side sill at the bottom, and to an angle iron at the top, so as to form a plate girder along each side of the car. The cross sills are 6-in. I-beams. On these cross sills rests the sheet steel bottom, which is of 3-16-in. sheet steel in the center of the car between the bolsters, and 5-16-in. from the bolsters to the ends of the car. The ¼-in. stiffening plates or braces seen in the engravings of the interior are to be covered by the backs of the seats. The photographs show the exterior side panels of the car as they will be when finished, except that they will, of course, be painted. Between posts on the inside of the car, wood furring faced with steel will be placed. The roof will be of wood, covered with canvas, as usual in car construction. The seat frames will be of pressed steel of the Hale & Kilburn make, as used on the all-steel cars for the New York subway. The weight of the car will be little if any more than the company's wooden cars of similar pattern, which is 48,000 lbs. without motors. On top of the steel bottom is placed a layer of mineral wool, and above this, wooden flooring. From an inspection of the illustrations it will be seen that the only wood employed in the construction is the flooring, the roof, the window sills and frames and some other details. A better idea of the construction can be gained from a close study of the excellent drawings and reproductions from photographs than from an extended description.

The design of the car has been worked out under the supervision of W. S. Menden, chief engineer of the Metropolitan West Side Elevated Railway Company, by whose courtesy these illustrations and details are presented.



EXTERIOR VIEW, SHOWING THE FRAMING OF THE ALL-STEEL CAR FOR THE METROPOLITAN WEST SIDE ELEVATED RAILWAY OF CHICAGO

In conjunction with the Big Four Railroad (steam), the Cleveland & South Western Traction Company last week handled a crowd of several hundred football enthusiasts from Columbus to Oberlin and return. The steam road took them from Columbus to Wellington, and the train was met by special interurban cars, which took them to Oberlin and back to Wellington in the evening. The excursion was arranged by the steam road, and it sold tickets clear through over the electric line. This illustrates the closer co-operation between steam and electric roads now so common in this district.

A. C. ELECTRIC TRACTION FROM GAS POWER TO BE USED BY THE WARREN & JAMESTOWN STREET RAILWAY COMPANY

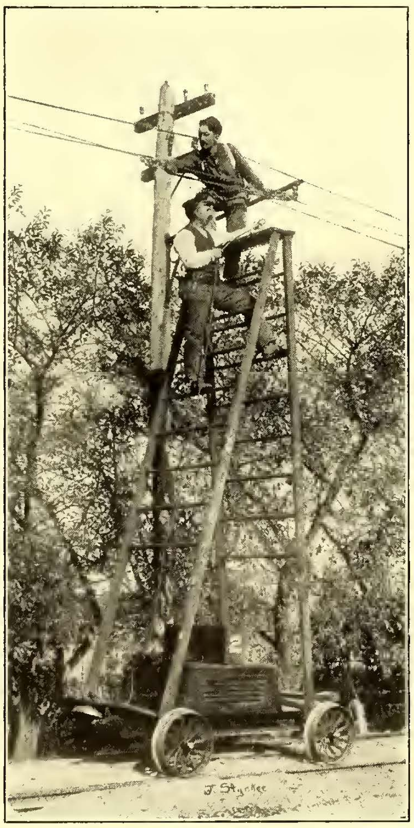
A somewhat unique departure from established methods in electric traction has recently been undertaken at Warren, Pa. The Warren & Jamestown Street Railway Company is equipping an a. c. single-phase electric railway system to operate between Warren, Pa., and Jamestown, N. Y., for which power will be supplied by gas engines operating upon natural gas. The equipment is now being constructed by the Westinghouse Companies at East Pittsburg, Pa. The power station will be located at Stoneham, Pa., 2 miles from Warren. The initial equipment will consist of two Westinghouse gas engines, each of 500-brake-hp capacity. They will be of the horizontal, single-crank, double-acting type, direct-connected to two 260-kw generators, furnishing current at voltage sufficient for direct use upon the high-tension transmission line. The power equipment also comprises a 55-hp Westinghouse gas engine for operating air compressor and exciter unit. Natural gas will be used, furnished by the local distributing company. In this district the gas has a calorific value of about 1000 B. T. U. per cubic foot.

Transformer sub-stations, five in number, will be located along the right of way. These will receive the high-tension current from the transmission line and reduce the voltage to such an extent as to render it more suitable for use in single-phase motors. The present motive power equipment will comprise four quadruple sets of Westinghouse single-phase motors, each approximately 50-hp capacity. An interesting feature of the system is the arrangement for operating the alternating-current motors upon the direct-current trolley lines within the city limits of the termini.

The Warren & Jamestown Street Railway is not a newly organized system, as it has operated part of the present lines for a period of eleven years. Three years ago the company began experimenting with the use of gas power, with sufficient success to secure the now exclusive adoption of gas engines for the company's entire power generation.

THE CLEVELAND & SOUTH WESTERN TRACTION COMPANY'S UNIQUE LINE CAR

H. A. Nicholl, general manager of the Cleveland & South Western Traction Company, has recently designed and put into service a novel emergency line car which shows a number of attractive features. Some time ago Mr. Nicholl purchased from the Olds Motor Works, of Detroit, one of its standard gasoline inspection cars, which he used to good advantage in the work for which it was designed. Recently he conceived the idea of fitting a ladder to the car and using it for line work. The car has a 62-in. wheel base, oak sills, 20-in. pressed steel wheels of M. C. B. standard, cold-rolled steel axles, Hyatt roller bearings and powerful brakes of the expanding clutch type. It is fitted with a standard Olds gasoline motor of 6 hp, with three changes of speed, giving a maximum speed of 30 miles an hour. There is tank capacity for water and gasoline sufficient to run the car 100 miles. The cost of operation is very slight, as 1 gallon of gasoline will drive the car 25 to 30 miles an hour. It is provided with a double seat, accommodating four men, and there are handles at each end of the frame so that the car can be lifted from the track by two men. The ladder is about 15 ft. in length, built of light strong wood, and the legs are provided with hinges, which permit the legs being dropped to a level with the car and extending out from the rear. By removing four bolts, the ladder may be removed and the car used for inspection work.

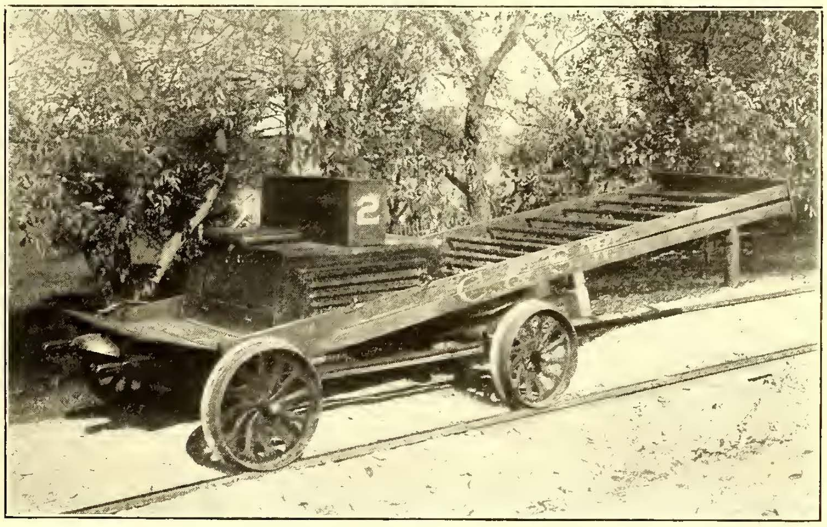


GASOLINE INSPECTION CAR, WITH LADDER ATTACHED, FOR USE IN OVERHEAD LINE WORK

The great advantage of a line car of this description is that it can be removed from the track at any time, thus saving the time lost in running to a siding when a car comes along. The car is fitted with a power acetylene gas headlight, which is swiveled so that it can be turned on the poles, which is a great advantage in locating line troubles on dark nights. Mr. Nicholl will equip two more of these cars, and station one on each of the three divisions of his system. Two men will be stationed with each car, and the use of the heavy line car will be done away with except for heavy work. Aside from its speed and convenience, the car has the added advantage that it may be used when the power is off.

The speed of cars of this type was demonstrated recently, when one of them made the run from Wellington to Cleveland, 47 miles, following a regular car and keeping on its time the entire distance. One of the standard cars recently made the run from Cleveland to Erie, 100 miles, on a steam road in four hours. The Railway Appliances Company, of Chicago, distributing agent for the Olds car, has sold a number of them to railroads, steam and electric, in all parts of this country and Canada, and has made shipments to Denmark, Russia, Siberia, Japan and other countries. It is stated that several of them are being used in war operations in the Far East.

CAR, WITH LADDER TAKEN DOWN, RUNNING ON AN ORDINARY ROAD



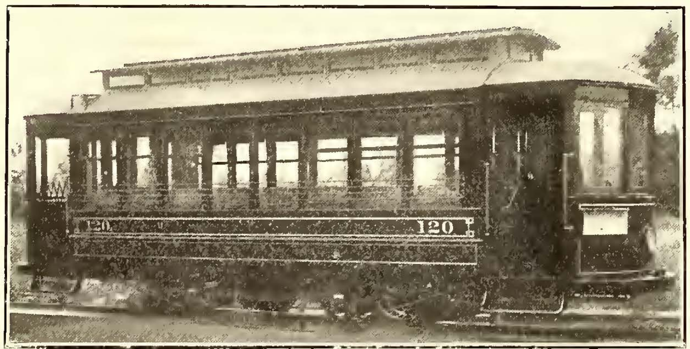
THE INSPECTION CAR RUNNING ON THE REGULAR TRACK

A new schedule has been put in effect upon the Philadelphia & Easton Street Railway by which cars are run through from Doylestown to Easton, Pa., a distance of 35 miles, in two hours. The cars do not run from the Philadelphia & Reading Railway station in Doylestown, as formerly, but start from the monument, nearer the business center, and run to the Lehigh Valley depot in South Easton, where a transfer is made to the local lines for Easton and Phillipsburg. A small car will run between the Reading depot and the borough line, giving a special local service through the town and making connections with the large cars at the monument.

Official time tables for the Pacific Electric Railway Company and the Los Angeles Railway Company recently have been prepared by their advertising agent, H. S. Kneedler. These are the first ever issued by the companies, and contain interesting descriptions of prominent scenic points along the lines.

SEMI-CONVERTIBLE CARS FOR THE NORTHERN TEXAS TRACTION COMPANY

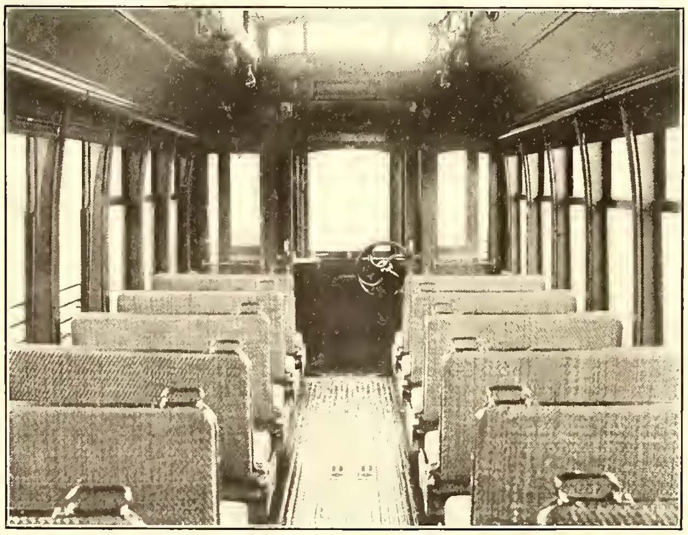
The Northern Texas Traction Company has recently added to its equipment six single-truck semi-convertible cars of the Brill type, built by the G. C. Kuhlman Car Company, Cleveland, Ohio. The railway company operates a system of local lines in Fort Worth and Dallas, and an interurban line connecting the two cities, making 60 miles of trackage and about seventy cars. The population between the two cities is comparatively small, nearly all the traffic being "through." At one of these towns along the route, Handley, the railway company controls a large and popular amusement resort, which is reached only by the cars of the company, and is about 7 miles from Fort



ONE OF THE NEW SEMI-CONVERTIBLE CARS FOR THE NORTHERN TEXAS TRACTION COMPANY

Worth. Dallas and Fort Worth are the two largest and most important cities in Northern Texas, each being a county seat and a commercial center.

The new cars are seated for thirty-two passengers. The seats are 35 ins. long, upholstered in spring canes, and are of the step-over back type. The aisle is 26 ins. wide. The interior is finished in cherry, with ceiling a green tint with gold stripes. The illustration shows some of the windows raised en-



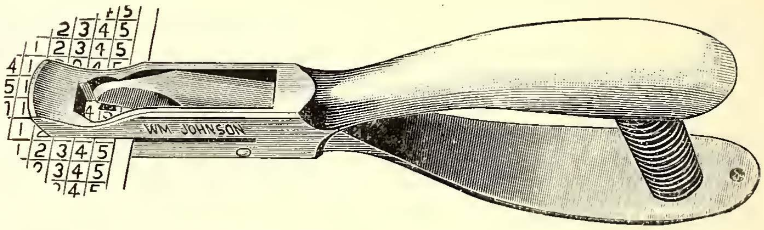
SEATING ARRANGEMENT OF NORTHERN TEXAS TRACTION COMPANY'S SEMI-CONVERTIBLE CAR.

tirely into the roof pockets; these windows can be held at any height at all that suits the convenience of the passenger. Arm rests are provided on the window sills, as the sills are too low to be used comfortably by adult passengers, and the four-bar window guards are an excellent precaution for the protection of the passengers when the windows are raised. The cars are complete in every respect, and being of the semi-convertible type, are particularly well adapted to the needs of the railway company.

The general dimensions of the cars are as follows: Length over end panels, 20 ft. 8 ins., and over the crown pieces, 30 ft. 1 in.; length of platform, 4 ft. 8½ ins.; width over the sills, 7 ft. 9½ ins., and over the posts at the belt, 8 ft.; thickness of corner posts, 3¾ ins., and of the side posts, 2¾ ins.; sweep of posts, 1¾ ins. The side sills are 5 ins. x 3⅜ ins., and the end sills are 3½ ins. x 6⅝ ins. The cars are equipped with Brill No. 21-E truck, with a wheel base of 7 ft. 6 ins., 33-in. wheels and 4-in. axles.

OPEN-SIGHT CONDUCTORS' PUNCH

In the operation of a railway, no device, however small, should be overlooked if it will do its work more quickly than some other contrivance for the same purpose. The punch shown in the accompanying cut was designed with this idea in mind, and its superiority is particularly noticeable when perforating transfer tickets, because the conductor readily can

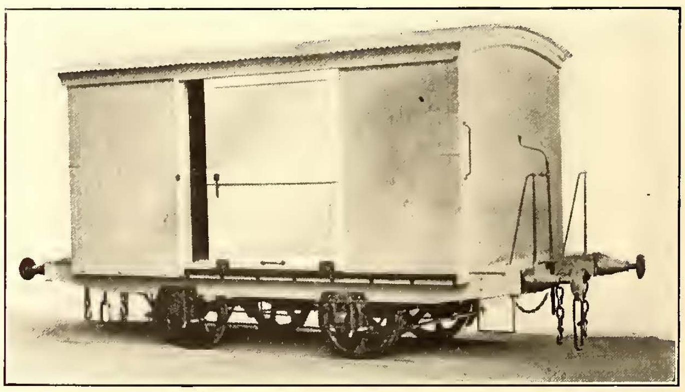


OPEN-SIGHT CONDUCTORS' PUNCH

see the figures and dates. This punch is made of nickel-plated steel in six styles for various kinds of work and different jaw reaches by William Johnson, Hedenberg Works, Newark, N. J.

FREIGHT CARS FOR BUENOS-AIRES

The J. G. Brill Company is shipping 122 freight, cattle and poultry cars to the Tramway Rural A Vapor, Buenos-Aires, Argentine. The railway extends west of the city to a level country, a distance of 22 miles. This section has a number of populous towns, besides the farms which supply the markets of the city, and for many years a considerable business has been done carrying freight, cattle and produce, in addition to the



FREIGHT CAR FOR THE BUENOS-AIRES ELECTRIC RAILWAY, BUENOS-AIRES, SOUTH AMERICA

regular passenger service. The enormous growth of Buenos-Aires and the modern character of its commercial and social conditions have required modern transportation facilities. As a consequence, the Tramway Rural A Vapor is about to change its motive power from steam to electricity, to enable the handling of a large number of cars on short headway. The population of Buenos-Aires is nearly a million and growing very rapidly. It is the largest city of South America, and one of the largest shipping ports in the world.

This lot of new cars is admirably adapted for the purposes intended. Fifty are 17-ft. box freight cars, like the one illustrated; fifty are 14 ft. in length and similar in appearance to the 17-ft. cars; six are 14 ft. in length and arranged for carrying poultry; ten are 30 ft. in length and are for cattle, and six 16-ft. cars are for baggage. All have sliding doors at the sides and short platforms at the end, on which spring buffers are mounted. The cars are all carried on gear trucks, with the exception of the ten cattle cars, which are mounted on diamond frame iron freight trucks. The cars are lightly but powerfully constructed; the one illustrated weighs 6475 lbs. The J. G. Brill Company builds a large number of cars of these and similar types for railways, plantation lines and other industrial purposes, and also have designed and built many of the electric locomotives used in such service.

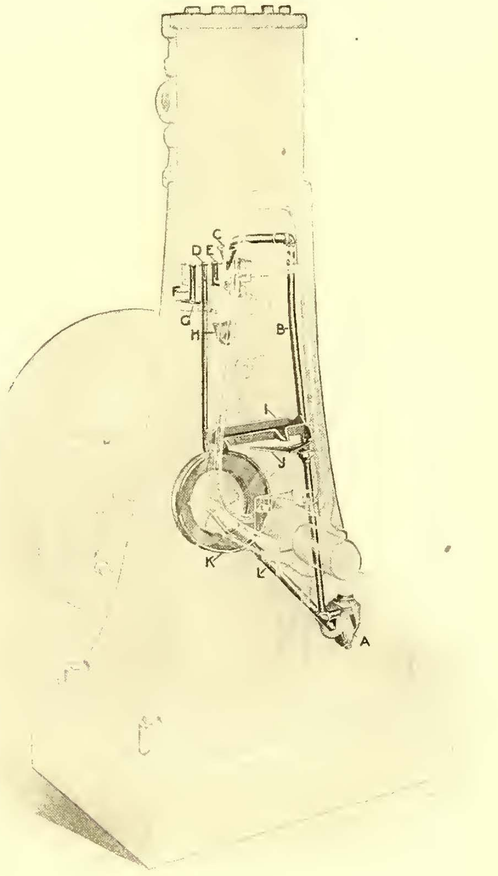
A WELL-LUBRICATED VERTICAL ENGINE

The illustration presented herewith shows a small vertical engine recently placed upon the market by the American Blower Company, of Detroit, Mich. It is claimed that the unique features of this engine tend to make it the best of its class yet produced. It will be seen that the engine has easy curves and graceful lines, giving it a handsome appearance. It is fully enclosed, preventing foreign matter getting into the working parts, yet the latter are easily accessible upon the removal of the enclosing plates, by simply turning a milled hand nut and lifting out.

The most remarkable feature of the engine is its oiling system. Automatic lubrication of engines has been one of the details very slow in development. Up to the present time it has been confined almost entirely to the splash system, which is seldom thoroughly effective, and for vertical double reciprocating engines is postively unreliable. Such attention as this detail has received has been given to large horizontal engines, which are less likely to prove annoying through defective lubrication than are the small high-speed vertical engines.

The system embodied in this engine is something entirely different from any of the usual methods, and is said to have proven successful far beyond the most sanguine expectations of its designers. Every frictional surface is running on oil, there being no positive contact between metals, with the effect of almost eliminating wear.

The oiling is done by the engine itself, and instead of a drop or two a minute, each bearing has a stream of oil. By referring to Fig. 1 the operation can be easily traced. An eccentric *K* on the shaft actuates the plunger *L* of the oil pump *A*, forcing the oil up through the tube *B* into the small strainer *C*. From *C* it drops into an oil box through the bottom of which four tubes project. In one side of each of these tubes there is a slot, so that when the oil box contains only a small amount of oil, each tube can take its proper proportion. In case the box is full, all the tubes get more oil in proportion to the increased height. Two of these tubes, *F* and *C*, and two on the opposite side, not lettered, apply oil to the guides, the oil dropping into a small oil trough *G*, from which it runs into the bearing through a small oil hole. The cross-head pin is supplied by the tube marked *E*, the oil drops into the cup *H*, and fills the cavity between the bolt and inside of cross-head pin and the oil grooves. The oil dropping from the cross-head is caught in two pans attached to the inside of the covers. From these oil pans it runs down the inside of the cover, dropping into a cup in the top of the main bearing cap. Instead of oil grooves at the top and bottom of the main bearing, as ordinarily made, in this system, the bearing is cut away at the joint. When the strain from the connecting rod is up, the oil is carried to the bottom of the bearing, but when the load is reversed there are no oil grooves to carry away this oil. The crank pin is oiled through the tube marked *D*. This tube discharges into a crank oil ring inside the eccentric *K*, which in turn discharges into the crank pin oil tube, and flows across the crank pin bearing. The crank pin oil ring, in addition to its independent supply, catches the drip from one end of the main bearing. The eccentric is oiled by the drip which it catches from the other end. Not the least difficulty has been experienced in catching the oil thrown off the eccentric strap, and the splash from the cross-head has been equally easy to take care of, the outside of the engine being absolutely free from oil. A portion of the oil as it drops back into the bottom of the frame, drops upon an oil filter, thoroughly cleaned and purified. The large base gives the oil an excellent opportunity to cool and settle.



VIEW SHOWING THE OPERATING DETAILS OF VERTICAL ENGINE

In their own shops the manufacturers have been experimenting with this engine for some two years past, and in connection with their experiments relate an experience which is little short of marvelous. An engine was adjusted and filled with oil on March 10; up to July 15 no adjustments of any character had been made, and no oil added except to fill the sight-feed cylinder lubricator. It has been operating from fourteen to sixteen hours per day driving a blower, and after the lapse of over four months really needed no adjustment or fresh lubricant, running almost as noiselessly as at first.

While this is a performance rarely if ever equaled by any other double-reciprocating engine, the builders claim that they expect every engine turned out to operate in an equally satisfactory manner. It will, therefore, readily be seen that this engine is particularly valuable for applications where continuous operation is required or peculiarly heavy duty imposed upon the engine, as in driving blowers, dynamos, pumps, etc.

FINANCIAL INTELLIGENCE

The Money Market

WALL STREET, Nov. 22, 1904.

The feature of the money market this week has been the continued strength in foreign exchange, rates advancing to a point where the shipments of gold coin could be made to Europe without loss. Heretofore the exports of gold have been confined to gold bars of the requisite fineness, but the supply of them being practically exhausted, the only recourse was the shipment of American eagles. While it is the general opinion in banking and exchange circles that the present rates show no profit on such transactions, it is presumed that Berlin, in its desire to draw gold from this center, allowed interest on the shipments while in transit. The rate for prime demand sterling touched 4.8715, the highest point of the season, and indications at present point to a still further advance, in which event additional exports of the precious metal may be expected, when the rates for money in New York advance to such an extent as to make them absolutely impossible. As yet the market has not reflected to any material extent the continued losses in cash resulting from the gold movement. The tone of the market continues firm, but rates for all classes of accommodation remain practically unchanged. Money on call has been in abundant supply at rates ranging from 2¼ to 3 per cent, with the bulk of the business at 2¼ and 2½ per cent. In the time money department, business has been practically at a standstill. The demand for funds has been extremely light, despite the continued activity and strength in the securities market, while on the other hand banks and trust companies have shown a desire to place their funds. For the short periods, funds were obtainable in quantities at 3¾ per cent, while for six months contracts have been made at 3½ per cent on all dividend-paying railway shares. Commercial paper has displayed more activity of late, local institutions being moderate purchasers of the choicest material, at rates ranging from 4 to 4½ per cent. The demand from out-of-town was good also, and the supply was more liberal. The indications at the close point to a continued firm market. During the balance of the year the local banks will be called upon to provide large sums of money for the flotation of various bond issues. Of these the sale this week of $25,000,000 New York 3½ per cent corporate stock is the most important. It is expected, however, that this money will remain on deposit for some time, or until called for by the city. In addition there are the Rock Island new 4 per cent bonds, the $15,000,000 Pennsylvania Railway collateral trust certificates, and the $10,800,000 car trust bonds issued by the same company, and the $6,000,000 Pere Marquette 3 per cents. Shortly after the first of the year the National Banks will be required to pay into the National Treasury 25 per cent of the government deposits, and the funds for the purchase of the new Japanese war loans will also become due in January.

The Stock Market

There was a material falling off in the dealings in the Stock Exchange this week, and price movements displayed decided irregularity. At the opening, there was heavy liquidation in many of the standard issues, but the ease with which the offerings of stock were absorbed was a matter of general comment. The news of the week was of a generally favorable character. Special interest was centered in the weekly bank statement, which made an unexpectedly good showing. The loss of $3,346,700 was about what the Street had looked for, but the further heavy contraction in loans of $12,379,200 was a complete surprise. The surplus reserve was $9,589,700, or $695,150 more than in the previous week.

During the last half of the week the market was influenced entirely by the developments in the money market. Foreign exchange continued to rise, prime demand sterling advancing to 4.8730, the highest price of the season, and resulting in additional shipments of gold to Europe and South America. These shipments were reflected by a sharp advance in the money rates, call loans advancing on Tuesday to 4 per cent, while time contracts for all maturities commanded 3¾ and 4 per cent. The sudden hardening of money rates was a signal for a general selling movement, and prices ran off sharply, and closed materially below those prevailing at the close of last week.

A very large business was transacted in the bond department, the particularly strong feature being Mexican Central issues, United States Steel sinking fund 5s, Colorado Fuel & Iron convertible 4s, Rock Island 5s and Union Pacific convertible 4s. The market closed heavy, but at slight recovery from the lowest prices.

Chicago

There have been a number of important developments in the Chicago Traction situation during the past week, the most important of which were those in connection with the merging of the various traction companies. Considerable interest attached to the visit of Judge Grosscup to New York, and it is understood that while a settlement of the matter has not yet been reached, the obstacles in the way of a successful consummation of the plan are being gradually removed. It is known that the political situation in the city is now more favorable to the traction interests than at any previous time, and it is expected that from now on the negotiations will proceed with more rapidity. At this writing, it is reported the powerful local and New York interests are handling the $36,000,000 organization scheme affecting the surface car lines. By this it is probable that the Chicago City Railway will not pass to the control of the Union Traction Company, but to a new syndicate, which may, at a later date, take over the entire stock of the latter company. The New York interests have sent a circular letter to the North and West Chicago Railway Companies, suggesting that they withdraw their proxies until the proposition develops more definite shape. The circular states that Hollins & Company will make a definite offer for the holdings ten days before the annual meetings of these companies.

Former Receiver Govin, of the Union Traction Company, has served notice on President Rawson, of the North and West Chicago Street Railway Companies, that at the January meetings of the stockholders, new boards of directors will be elected for the underlying companies that will be more friendly to the Union Traction than the present officials. It is expected that a war between the local and Eastern interests will follow.

Dealings in the various issues were extremely small, there being a general disposition to await further developments. Prices, however, remained strong, and in many issues sharp advances were made. Metropolitan Elevated common moved up 1¾ points to 25¼, but later there was a reaction to 25, the latter figure showing a net gain of 1½ points. The preferred sold at 66 and 67. Northwestern Elevated was conspicuously strong on renewed reports that progress was making in the proposed combination of the Chicago elevated railroads. From 23 at the opening, the price advanced to 26¼ on the purchase of odd lots, a gain of 2¾ points. South Side Elevated sold at 95 and 96, and Chicago Oak Park Elevated brought 7 to 7½, while the preferred changed hands at 26½ for an odd lot. Chicago City Railway advanced 3 points to 189 to 188½. North Chicago sold at 78, and West Chicago brought 45. There is a strong belief in certain quarters that Metropolitan West Side Elevated will declare a dividend on the preferred stock next February. It is said that the necessary surplus has been accumulated and that the company can easily pay 2 per cent.

Philadelphia

Considerable less interest was manifest in the local traction issues this week. Dealings in them were materially smaller than in the preceding week, and, although prices were irregularly inclined, the undertone remained firm. Philadelphia Rapid Transit, which displayed extreme activity, was comparatively quiet, about 7000 shares changing hands at from 18⅝ to 17⅝. Consolidated Traction of New Jersey lost ¼, 100 shares changing hands at 77⅞. Philadelphia Traction advanced ¼ to 98 on light purchases, and Fairmount Park Transportation advanced a point to 17. Philadelphia Company's stocks were practically unchanged, the common selling at 41, and the preferred at 46 to 45¾. Railway Companies General sold at from 3½ to 4. Union Traction was dealt in to the extent of 105 shares at 59, and United Gas & Improvement brought 107¼ to 106⅞.

Other Traction Securities

Extreme dullness prevailed in the Boston market, but prices generally showed pronounced strength. Boston Elevated recovered all of last week's decline, the price advancing ½ to 155 on the transfer of small amounts of the stock. Massachusetts Electric common advanced a fraction, several hundred shares in odd amounts changing hands at prices ranging from 15¾ up to 16¾ and back to 16. The preferred stock displayed pronounced strength, sales taking place at 58¼ and 59, the latter figure being a net gain of 2 points. West End advanced ½ from 91½ to 92. In the Baltimore market interest centered almost entirely in United Railway bonds, trading in them being stimulated by the reports that the company would sell the $2,000,000 Sparrow Point Railway bonds, which would mean the liquidation of a large loan made to the company on part of these bonds as security. The income bonds were particularly active and strong, the price advancing 2¾ points to 48. While the 4s sold in fairly large amounts at 92 and 92½. The stock also responded, sales taking place at from 8¼ up to 9, and back to 8¾, a net gain of ¾. Norfolk Railway and Light 5s advanced a point to 91, and Lexington Street Railway 5s brought 103¾. In the New York curb market Interborough Rapid Transit was fairly active and firm, about 10,000 shares of the stock changing owners at from 156 to 154⅞, the final transaction being at 156, a net gain of ¼ for the week. Washington Railway common was an exceptionally strong feature, the price advancing 4 points to 28½. The 4 per cent bonds were in excellent demand for investment, about $20,000 of them being taken at from 85 to 88, an advance of 3 points.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Closing Bid Nov. 16	Closing Bid Nov. 23
American Railways	50	49¾
Aurora, Elgin & Chicago	—	—
Boston Elevated	154	154
Brooklyn Rapid Transit	68¾	68½
Chicago City	180	190
Chicago Union Traction (common)	13	15
Chicago Union Traction (preferred)	40	45
Cleveland Electric	—	—
Consolidated Traction of New Jersey	77¾	77½
Consolidated Traction of New Jersey 5s	110	110½
Detroit United	76¾	77½
Interborough Rapid Transit	153	159
Lake Street Elevated	3⅛	—
Manhattan Railway	167⅛	167
Massachusetts Electric Cos. (common)	16⅜	16
Massachusetts Electric Cos. (preferred)	58	61
Metropolitan Elevated, Chicago (common)	23	24¾
Metropolitan Elevated, Chicago (preferred)	66¼	66½
Metropolitan Street	124⅜	124
Metropolitan Securities	82¼	82
New Orleans Railways (common)	9½	9
New Orleans Railways (preferred)	27	27¾
New Orleans Railways, 4½s	75	80½
North American	105	104½
Northern Ohio Traction & Light	—	—
Philadelphia Company (common)	40⅞	40⅞
Philadelphia Rapid Transit	18½	17½
Philadelphia Traction	98	97¾
South Side Elevated (Chicago)	—	—
Third Avenue	132	131
Twin City, Minneapolis (common)	106½	106½
Union Traction (Philadelphia)	58½	58⅞
United Railways, St. Louis (preferred)	68½	68½
West End (common)	91½	91½
West End (preferred)	112	112

SAN FRANCISCO CARS TO STOP ON NEAR SIDE OF STREET

Orders have been published by the United Railroads of San Francisco, effective Nov. 15, that all cars shall stop only on the near side of street crossings, excepting where there is a "Cars Stop Here" sign at some other point on the crossing, in which case the stop will be made opposite the sign. On electric lines the signs will be hung from the span wire and on cable roads the sign will be in the form of a plate in the pavement. About two years ago there were a number of collisions on the lines of the system due to cars not being brought to a stop at crossings. This led to the strict enforcement of the rule that all cars must come to a full stop before crossing another railway track. Then if there were passengers to be picked up or let off at that street another stop was necessary at the farther side of the crossing. The trainmen, unwilling to make both stops, began to neglect the second one, and this has resulted in the present order, which is a general one affecting the whole system, and makes necessary but one stop at a crossing. The exceptions to the rule are at points at the foot of hills and at places on the cable lines where a stop on the near side of the street is not possible. At all such points the signs will be conspicuously displayed. The management does not anticipate any serious trouble in instructing the riding public, as notices will be carried permanently in the cars. There will not be the objection to the near-side stop that is raised by Eastern cities which have snow and slush to contend with, as San Francisco is free from snow and ice.

TRANSACTIONS OF THE INTERNATIONAL ELECTRICAL CONGRESS

The complete transactions of the International Electrical Congress, which were reported in the Oct. 1 issue of this paper, are now being prepared for the press, and will contain 153 specially invited papers, together with the discussions thereon at St. Louis, and a report of the proceedings of the Chamber of Delegates. They will form three large octavo volumes, each of which will contain about 900 pages. The membership roll of the Congress closed on the last day of the meeting, Sept. 17, but anyone desiring to obtain a copy of the transactions can do so by subscription, which will be received until Dec. 1. The subscription price is $10, which includes the cost of delivery to the subscriber. As it is not intended to print a reserve stock, and only those for the Congress membership, or on order, are being at present printed, orders should be sent in promptly to the treasurer, W. D. Weaver, 114 Liberty Street, New York City. The volumes will contribute a valuable landmark in the literature of electrical science and engineering.

THE INTERBOROUGH RAPID TRANSIT REPORT

The Interborough Rapid Transit Company, controlling the elevated and the subway lines in New York, reports as follows for the quarter ended Sept. 30, last:

	1904	1903
Gross earnings	$3,232,549	$2,938,753
Operating expenses	1,369,094	1,307,621
Net earnings	$1,863,855	$1,631,132
Other income	79,000	80,287
Total income	$1,942,855	$1,711,419
Charges	1,531,144	1,496,475
Surplus	$411,711	$214,944

The company reports cash on hand of $641,384 and a total profit and loss surplus of $2,184,359. The general balance sheet of the company, as of September 30, 1904, filed with the State Railroad Commission, shows:

ASSETS

	1904	1903
Cost lease and equipment	$17,270,454	$7,080,800
Stock and bonds	16,348,690	13,527,265
Real estate	1,673,234	1,400,176
Supplies on hand	1,138,948	696,147
Due by agents	180	85
Due by others	9,448	8,761
Open accounts	996,032	139,059
Cash on hand	641,385	10,717,870
Manhattan guarantee fund	4,018,812	4,018,812
Prepaid insurance	73,845	7,999
Sundries	7,150	4,813
Loaned on collateral	143,000	......
Total	$42,321,278	$37,601,790

LIABILITIES

	1904	1903
Capital stock	$35,000,000	$35,000,000
Manhattan Railway lease	379,860	409,451
Due for wages	90,789	117,159
Due for supplies	657,246	410,459
Open accounts	14,866	19,030
Interest and premium on capital stock	679,252	404,207
Interest due and accrued	166,413	171,413
Taxes in litigation	1,084,165	303,000
Loans and bills payable	2,000,000	......
Sundries	64,228	4,704
Profit and loss surplus	2,184,359	762,267
Total	$42,321,178	$37,601,790

NEW ENGLAND STREET RAILWAY CLUB MEETING

The November meeting of the New England Street Railway Club will be held in the American House, Hanover Street, Boston, on Tuesday evening, Nov. 29. Dinner will be served at 6:30, and at 8 o'clock the regular business meeting will be held, followed with a paper by Clarence Renshaw, assistant to the chief engineer of the Westinghouse Electric & Manufacturing Company, on "Single-Phase Alternating-Current Traction." The paper will be illustrated with a stereopticon. As a large attendance is expected, only members will be admitted. Tickets are not transferable. In order to determine the number to be provided for at the dinner, it is requested that tickets be purchased of the secretary before the day of the meeting.

CLEVELAND COMPANY TO ORDER CARS

The Cleveland Electric Railway Company will shortly place contracts for fifty new cars. The company is so well pleased with the cars which it has reconstructed and made into convertible ones that the new cars will be of this type. The side of the devil strip will be closed and will have drop windows, while the outside will have removable panels, making them practically summer cars with entrance from a running board. The company has been using two convertible trail cars of a type recently illustrated in the STREET RAILWAY JOURNAL, but the results obtained thus far have not been wholly satisfactory, as it was found almost impossible to maintain schedules running a trailer now and then. The first time the car was tried it lost thirteen minutes on a run of 7 miles, and as this was on a line where there is a one minute headway, the loss of time was a serious matter. The best the cars have been able to do has been a loss of three minutes from the regular schedule. Even this is undesirable. It seems probable that additional cars of this type will not be purchased. Those now in service will, however, be used from time to time.

NEW YORK AND WESTCHESTER COMPANY'S APPLICATION APPROVED—CONTRACT LET FOR CONSTRUCTION

The New York State Board of Railroad Commissioners has announced its approval of the proposed increase of capital stock of the New York, Westchester & Boston Railway Company from $1,000,000 to $20,000,000 and of the proposed first mortgage upon the company's property for $20,000,000.

The company is chartered to build a railroad from the Harlem River to Port Chester, with a branch from Pelham to White Plains and another branch to Classon's Point and Throg's Neck, on Long Island Sound. Its plans provide for a well-equipped four-track electric railway over a private right of way.

The Board of Aldermen of New York City in February last passed an ordinance granting the consent of the municipality to the crossing of streets within the city limits, but the ordinance was vetoed by Mayor McClellan on the ground that it was not sufficiently restricted and did not provide for compensation to the city. The railroad company renewed its application and the matter was referred to the Board of Estimate and Apportionment. Upon the report of Controller Grout an ordinance fixing new terms and conditions was recommended to the Board of Aldermen and passed by that body.

In a communication to the STREET RAILWAY JOURNAL, Dick & Robinson, who are backing the enterprise, say:

"A mortgage bond for $20,000,000, payable in fifty years at 5 per cent, in favor of the Knickerbocker Trust Company, as trustee, has been filed with the registers of New York and Westchester Counties. The company also paid its State tax of one-twentieth of 1 per cent, amounting to $9,500, on the $19,000,000 additional capital stock. The company has been financed from the beginning, and none of its securities will be placed on the market until the road has been completed.

"The contract for the building of the road has now been let. The company is at present negotiating for the lease of executive offices in a downtown building, and an adequate office force is being employed. The purchase of the right of way of the line will be undertaken immediately, and it is the intention to begin actual construction in the spring. Aside from the mention of the bankers and William L. Bull, the president, it has not been hitherto deemed advisable to make public the financial interests which will build the road. The board of directors will be completed within the next month, and the publication of their names will reveal all the interests actively supporting this enterprise."

TEST OF SPRINKLER SYSTEM FOR CAR HOUSES IN NEWARK

On Nov. 30, or thereabout, one of the most elaborate tests ever conducted of sprinklers for protecting car houses will be conducted in Newark at the Belleville Avenue car house of the Public Service Corporation under the direction of the Underwriters' Electrical Bureau, of New York. This car house, which is 80 ft. wide and 150 ft. long, has been thoroughly equipped with a system of sprinklers which has been devised under the supervision of B. E. Loomis, of the Underwriters' Electrical Bureau, and which involves a number of novel and meritorious features. It is the plan to make a series of tests on some twelve cars, starting fires within the cars under different conditions, and determining how effectually and how quickly the fire can be extinguished.

This test is the culmination of a large number of requests made by railway companies to the underwriters to suggest effective methods of protecting car houses, and has been undertaken by the insurance companies at their own expense to determine the most desirable method of effecting this result. If the results secured at the test in Newark are satisfactory to the insurance interests, they will undoubtedly be followed by a considerable reduction in rates on car houses, provided the sprinkler system is adopted. A number of invitations to witness these tests will be extended by the underwriters, but all officers of railway companies will be welcomed at the tests, provided they notify Mr. Loomis, of the Underwriters' Electrical Bureau, 71 William Street, New York, of their wish to be present.

MASSACHUSETTS COMMISSIONERS RULE AGAINST LOWER FARES ON A LINE

A lesson in economics has been taught the residents of Mattapoisett, Marion and Warcham, in Massachusetts, and something has been done toward exploding in the State the fallacy, popular with the public at large, that the policy is right of loading down franchises to corporations with conditions that go to the limit in protecting what the people term their "rights." In this particular instance the clause in the interest of the public that required the New Bedford & Onset Bay Company—for that is the name of the company in whose favor the commissioners have ruled—to pave practically the entire route of its line in one of the towns through which it operates, proved to be such a burden that the company was compelled to increase its fares to meet the charges for maintenance, thus converting the clause dear to the public into a boomerang that seems to have had almost deadly affect upon the residents of the towns, so loud is the complaint at the company's action.

When the towns made their grants to the company stipulations regarding fares were inserted. It was provided that not more than 5 cents should be charged within the limits of Mattapoisett and Marion and 10 cents in Wareham. It soon became apparent to the company that the volume of traffic was not such as to make adequate returns for the very severe conditions imposed by the various franchises. Taking advantage of the decision of the Supreme Court of the State that Selectmen have no authority over fares on street railways, and that the acceptance of a location which purports to fix them does not create any contract between the company and the town, the company added 10 cents to the through fare between the towns. The indignation of the towns at this action finally expressed itself in a petition to the commissioners for a revision of the fares, in which allegations against the company were made that it was trying to recoup itself of what had proved to be an excessive first cost in construction.

After reviewing the financial condition of the company the board, in answer to the Selectmen's charge that the road was extravagantly built and that the patrons were being asked to bear this burden, says:

We do not hesitate to say that if the recent increase in fares was made in order to secure a return upon any unnecessary investment in power plant, or to make good a loss in rental of surplus power, or to recoup unnecessary expenses in operating this power plant, we should deem the increase in fares unreasonable. After careful examination, however, we do not find that this change in fares was made in order to meet any such loss or expense, or to pay dividends on such investment.

An unusual item of expense in construction was the large outlay for street improvements, particularly in one of the towns in which locations were obtained. To the extent that changes in, or additions to, highways are made necessary in order to accommodate a street railway, it is clearly right that the company should pay the cost. To compel a company, however, to meet the whole expense of a new highway, which is to be built for the use of the general public as well as that of the street railway, is a questionable policy. To say nothing of the consequent unequal distribution of advantages and disadvantages between different towns, it is to be borne in mind that the traveling public must contribute in fares to dividends on the capital invested in this added cost of the railway.

FRANCHISE RENEWALS IN CLEVELAND

The street railway franchise settlement question has again been opened in Cleveland. At the meeting of the Council Monday evening, Nov. 14, Councilman Walker, a Republican, introduced an ordinance which, in brief, provides for the extension of franchises of all lines of the Cleveland Electric Railway for twenty years. In return for this the company is to make a fare of seven tickets for a quarter and transfers from one line to another and to and from crosstown lines. The right is reserved to the city to grant any other person or corporation permission to joint use of tracks, poles, etc., upon such terms as the Council may deem proper. The matter has been referred to the street railway committee, which will hold a public hearing. The new franchise does not have the backing of the company, neither does it appear to have been prompted by Mayor Tom L. Johnson and his associates. Evidently it was proposed by well-meaning Republicans, who hope to secure the best possible terms for the city and settle the question equitably.

CHICAGO TRACTION MATTERS

Judge Grosscup, in whose court the affairs of the Chicago Union Traction receivership are directed, made a trip to New York last week for the openly avowed purpose of impressing the financial backers of the Chicago Union Traction Company with the necessity of either taking some action with regard to consolidation with the Chicago City Railway Company or letting the Chicago Union Traction Company settle its franchises without regard to the City Railway. The judge was in conference in New York with the Eastern representatives of the company on Friday, Nov. 18. Later in the day he returned to Chicago. It is said in New York that the chief obstacles to the proposed merger of the companies have been overcome. An announcement is expected to be made by the judge in Chicago of the result of the conference.

NEW YORK CITY RAILWAY REPORT

The consolidated comparative statement of earnings and expenses of the New York City Railway Company, operating all the surface lines in the city, for the quarters ending Sept. 30, 1904, shows:

	1904	1903
Gross earnings from operation	$5,564,575	$5,570,212
Operating expenses	2,789,167	2,761,600
Net earnings from operation	$2,775,408	$2,808,611
Income from other sources	298,778	370,224
Gross income from all sources	$3,074,186	$3,178,836
Deductions from income	3,135,263	3,015,459
Surplus		$163,376
Deficit	$61,077	

ADDITIONAL ST. LOUIS AWARDS

The 20-in. x 27-in. stroke Corliss valve, Ball & Wood engine on exhibition in the Philippine Government Board section of the Louisiana Purchase Exposition, World's Fair, has been awarded a gold medal by the International Filipino Jury of the Exposition.

The Locke Insulator Manufacturing Company, of Victor, N. Y., will receive as an award at the St. Louis Exposition a gold medal for its exhibit of high-potential glass and porcelain insulators and special insulating material.

The Land and Sea Cable Works, Ltd., of Nippes-Cologne, Germany, have been awarded the gold medal at the St. Louis Exhibition. Last year they were awarded a gold medal at Dusseldorf, Germany, for an exhibit of their achievements in cable manufacture.

The D. & W. Fuse Company, of Providence, R. I., has been awarded a silver medal in recognition of its exhibit at the St. Louis Exposition. To the best of this company's knowledge, this is the highest award allowed for this class of equipment.

The Elliott Frog & Switch Company, of East St. Louis, Ill., has been awarded a medal on its exhibit at the Louisiana Purchase Exposition. While this company makes track appliances for electric and interurban lines, its exhibit was confined to material used by steam railroads and consisted of "Eureka" spring rail frog for main line service, the improved sliding frog and split switches showing improvements in adjustable features. The company also exhibited its rigid frogs, switch stands and hasty three-throw split switch.

OHMER REGISTERS IN NEW JERSEY

The Public Service Corporation, of New Jersey, has recently placed an order for 300 registers with the Ohmer Fare Register Company, and these registers have just been installed. They are in use on some sixteen different divisions of the Public Service Corporation, and are of three classes. About seventy-five are of the Ohmer No. 5, two-class; seventy-five are of the No. 5, six-class, and about 150 are of the Ohmer No. 4, twelve-class. The latter are, of course, used on the long-distance lines of the company, on which a large number of fares is charged. The Ohmer Company has been doing considerable work in the East, and, among other roads, has equipped the Providence & Danielson Railway, of Providence, R. I., and the New York & Long Island Traction Company.

OTTAWA COMPANY OFFERS TO SELL TO CITY

The Ottawa Electric Railway Company, of Ottawa, Can., has offered to sell its property to the city. A letter outlining the proposal has been sent to the Mayor by the company, and a consultation has already been held between the city officials and the representatives of the company to consider the question. That part of the communication of the company setting forth the financial consideration involved says: "The fixing of a minimum price which will be fair to the stockholders has not been decided upon without careful consideration. I am, therefore, instructed to state that if an offer of $250 per share for the capital stock of the company is made by the city, subject to ratification by by-law and legislation, the board of this company will agree to recommend to the shareholders the acceptance of the offer, payment to be made in the city of Ottawa 4 per cent bonds in accordance with the suggestion of your deputation. I am further instructed to add that the price mentioned is the lowest that can be considered."

A NEW INTERURBAN FOR LONG ISLAND

The South Shore Traction Company, incorporated under the laws of the State of New York with a capital stock of $2,000,000 (bond issue of $3,000,000 under application) and which was recently granted a certificate of necessity of route by the Board of Railroad Commissioners, proposes to build and operate an electric railway to run in an easterly direction from the Greater New York line through the county of Nassau and part of the county of Suffolk, Long Island.

The president of the company is George E. Fisher, of New York City; James Anderson Hawes, of New York City, is vice-president, while Arthur C. Hume is secretary. James F. Heyward, formerly general manager of the City & Suburban Railway of Baltimore, is general manager and treasurer.

The entire length of the system will be about 51 miles. The route will be through a territory which is expected to increase in population rapidly because of the additional facilities which will be given by the proposed tunnels and bridges connecting Manhattan and Long Island. The line will be built from the Connecticut River through Brookhaven, Bellport, Hagerman, Patchogue, Blue Point, Bayport, Sayville, Oakdale, Great River, Islip, Bayshore, Babylon, Lindenhurst, Copaigue, Amityville, Massapequa, Seaford, Wantagh, Bellmore, Merrick, Freeport, Baldwins, Rockville Center, Lynbrook and Valley Stream to Central Avenue and the Greater New York line.

The company has secured perpetual franchises from the town authorities of Brookhaven, Islip, Babylon and Oyster Bay, and has also obtained franchises from the villages of Patchogue and Amityville, the franchise from the village of Patchogue being perpetual, while that granted by the village of Amityville is for twenty-five years with the privilege of renewal for another twenty-five years. While it is true that most of the villages through which the proposed road will run are small, they are located very close together, being considerably less than 2 miles apart on the average. This means a scattered village population, desirable and profitable from a railway standpoint.

As about half of the proposed road will be on private right of way, it is anticipated that it will be possible to maintain a schedule speed of 15 miles an hour.

The company is not at present ready to give out for publication definite plans in regard to its power house, equipment, etc., but it is understood that the construction of a central power station of about 3000-kw capacity is contemplated.

Construction work will be commenced either late this fall or early next spring.

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED NOV. 15, 1904

774,896. Electric Safety Apparatus for Cars or Trains; William P. Robertson, Bronxville, N. Y. App. filed May 12, 1904. The doors of the cars are connected in a circuit whereby the motorman is prevented from starting the train until all the doors are closed.

774,938. Car Seat; Samuel M. Curwen, Philadelphia, Pa. App. filed May 16, 1904. A curved panel supports one end of the seat, a single link pivoted so as to move between the panel and curved ends of the seat, a back supported at one end of the curved link and means for supporting the other end of the back.

774,983. Car Fender; Charles Coehring, Brooklyn, N. Y. App. filed May 21, 1904. Details of construction.

775,023. Switch Operating Apparatus; John Bace, Tacoma, Wash. App. filed June 30, 1904. Mechanical connections such that when either of two blocks in the roadbed is depressed the switch point will be thrown in one direction or the other, depending upon which block is depressed.

775,064. Automatic Railway Switch Adjuster; William T. Harris, Ellettsville, Ind. App. filed June 15, 1904. Details of a switch from a side to a main track adapted to be automatically operated by a suitable trip device on the train engaging a lever in the roadbed.

775,082. Rail Bond; Edward P. Howe, Newburyport, Mass. App. filed Feb. 23, 1904. Solder plates riveted to the bottom of each flat foot of the bond, having upturned lips preventing them from changing their position on the rivets.

775,276. Trolley System for Overhead Electric Lines; James B. Kline, Warren, Pa. App. filed Oct. 19, 1904. The under side of the trolley wheel is protected by a U-shaped housing which prevents the wheel from hooking over the wire when being adjusted thereto.

775,280. Roller Bearing Brake-Shoe; James N. McNeace, Cincinnati, Ohio. App. filed June 21, 1902. Consists of a series of bearing-rollers arranged in the face of the shoe, each having antifriction rollers surrounding its journals.

775,287. Car Fender; Peter Best, Elizabeth, N. J. App. filed Feb. 23, 1904. A fender constructed to buckle or bend in the middle, a rotary shaft supporting the fender, a spring connected with the shaft and stretched by the buckling of the fender and means for controlling the action of the spring and shaft.

CONTRACT ABOUT TO BE LET

The Mankato Railway, Light & Power Company, of Mankato, Minn., will receive bids about Dec. 15 for the construction of a complete railway, light, heat and power plant. Plans and specifications are now being drawn by Oscar Claussen, Room 514, National German-American Bank Building, St. Paul, Minn.

AMERICAN CARS FOR YERKES' LONDON SYSTEM

The American Car & Foundry Company recently secured a contract for 125 steel-framed cars, for use in the Yerkes' system of underground electric railways in and around London, England The plans regarding same, however, are not yet definitely worked out, but are expected to be ready in about six weeks, the mechanical department of the contracting parties being now at work on the details. The American Car & Foundry Company is figuring on building more cars for the same British system.

Shops for the purpose of assembling the various parts of the cars are to be installed on the other side. There have been reports to the effect that these shops were to serve as the nucleus for a large plant for building cars for the British markets. These rumors were, however, denied in an interview that a representative of the STREET RAILWAY JOURNAL had with an officer of the American Car & Foundry Company. Delivery on the Yerkes' cars will begin in February.

PERSONAL MENTION

MR. E. W. BROWN, for several years chief electrician of the Pueblo Traction & Lighting Company, is dead.

HON. JOHN C. BRADY, president of the Erie Motor Company and ex-Mayor of Erie, is dead, aged forty-six years. He is survived by his widow and one child.

MR. W. J. CANADA, electrical engineer of the Appleyard syndicate's interurban lines in Ohio, has moved his office from Springfield to the general office at Columbus.

MR. J. B. WILSON has been elected president of the Dallas Electric Street Railway Company to succeed Mr. E. J. Gannon, who resigned recently on account of having been elected City Treasurer. To fill the vacancy left in the board of directors by Mr. Wilson's retirement, Mr. Royal A. Ferris has been chosen as a director.

MR. J. S. HAMLIN, formerly of the National Electric Company and at one time master mechanic of the Indiana Union Traction Company, is now local representative of the St. Louis Car Company at Chicago, with headquarters in that city, where he will look after the St. Louis Car Company's business in Chicago and immediate vicinity.

IN THE CURRENT ISSUE of "The Gateway" there is published in an interview with Mr. James D. Hawks, in which he discusses frankly some of the causes of railroad wrecks. Mr. Hawks is president of the Detroit & Mackinac Railroad, the Detroit, Ypsilanti, Ann Arbor & Jackson Electric Railway and the Grand Rapids, Grand Haven & Muskegon Railway.

MR. CHARLES N. WOOD, who, for a long time has been prominently identified with the Frank Ridlon Company, of Boston, has severed his connection with that company. Mr. Wood has been long and favorably known in the street railway trade, and has announced that he will engage in the electric railway supply business in Boston, under the name of the Charles N. Wood Electric Company.

MR. ARTHUR W. SENTER, for the last six years superintendent of the employment department of the Boston Elevated Railway Company, has been appointed superintendent of the second division, to succeed Mr. Joseph M. Gould, who has been retired on account of impaired health, although he remains in the service of the company. Mr. Senter is thirty-six years of age, having been born in Hudson, N. H., in 1868. He came to Boston in 1885 and secured employment as conductor with the South Boston Street Railway Company. After two years of service as conductor, Mr. Senter was appointed to a clerkship in the receiving department, and nine months later he was transferred to the auditor's office, where he served for five years, the last three years as chief clerk of revenue accounts. His next promotion was to that of chief clerk of the second division, which office he held five years, and then he was promoted to be superintendent of employment.

MR. OREN S. HUSSEY has recently been elected vice-president of the Frank Ridlon Company, and has already assumed his duties as an executive officer of the company. Mr. Hussey is a graduate of Massachusetts Institute of Technology and is a member of the American Society of Mechanical Engineers. After graduation Mr. Hussey entered the laboratories of Mr. Thomas A. Edison, where he remained for two years, doing original research work. Mr. Hussey next entered the service of the Thomson-Houston Company, as manager of the Boston office. Subsequently he engaged in manufacturing, which business he has followed until his recent election to the vice-presidency of the Frank Ridlon Company. Mr. Henry F. Kellogg, for several years with this company as traveling salesman, has recently been advanced to sales manager of the railway department. Mr. Kellogg will hereafter direct the sales organization of the company from the Boston office.

CAPTAIN E. A. SAWTELLE, who has been for a long time with the Westinghouse interests, both in America and England, has just sailed from London, and will be married early in December at Irvington-on-the-Hudson, to Miss Julia H. Worthington, daughter of Mr. Chas. C. Worthington, son of Mr. Henry R. Worthington, who is so well known to all engineers. Captain Sawtelle, who is the son of Brig. Gen. Charles G. Sawtelle, of the United States Army, commenced his career in the Westinghouse works at Pittsburg in 1892, staying there until 1893, when he was one of the engineers selected by the Westinghouse Company to take charge of its World's Fair exhibit in Chicago. From 1894 to 1898 Captain Sawtelle was engaged in general commercial engineering in the Westinghouse Company's interests, for a long time making his headquarters in Cleveland. During the Spanish-American war he was appointed to the United States Volunteer Engineers, of which General Griffin was colonel, most of his time, while attached to this regiment, being passed in Porto Rico. Soon after the termination of the war Captain Sawtelle went to London in the Westinghouse interests, where he has since occupied one of the most important positions connected with the London district. It is, perhaps, not too much to state that Captain Sawtelle is one of the most popular Americans who has ever visited England on electrical business, not only from a social point of view, but also with all whom he has come in contact in a business way.